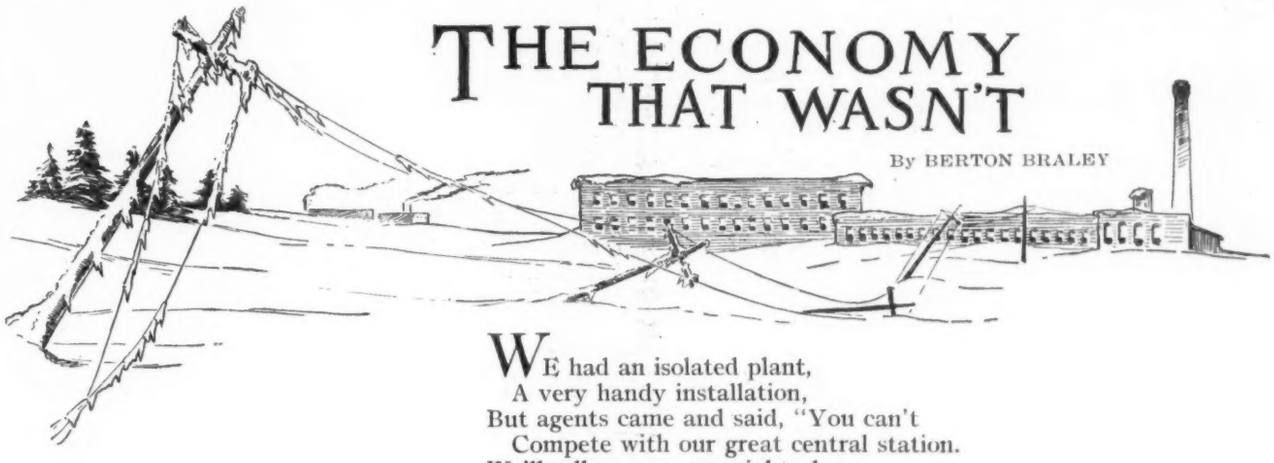
POWER

Vol. 40 NEW YORK, NOVEMBER 24, 1914 No. 21



THE ECONOMY THAT WASN'T

By BERTON BRALEY

WE had an isolated plant,
A very handy installation,
But agents came and said, "You can't
Compete with our great central station.
We'll sell you power mighty low,
Much cheaper than you'll ever make it.
By facts and figures we can show
How much you'll save if you will take it."

They washed our arguments away
With floods of figures almost tidal,
Persuading us that it would pay
To let our little plant lie idle.
They got us on their list, all right,
The service proved most efficacious,
And oh we thought that we were bright
And almost brilliantly sagacious.

And then—and then the power failed.
"The lines were down," somewhere or other
And while we ranted and we railed
We lost a day—and spoiled another.
We raved and 'phoned, and 'phoned and raved
We talked both angrily and sweetly.
It mattered not how we behaved,
The power still was dead—completely.

They got it going by and by
And promised us no further worry,
But wintertime was drawing nigh
When people don their garments furry.
We started up our winter fires
To meet that chilly situation.
(It's hard to heat your plant with wires
Connected with a power station).

Our coal bill proved almost as great
As when our plant gave heat AND power,
And now we have to add the rate
We pay per kilowatt per hour.
In fact we haven't saved a bit;
The old plant made the better showing,
And we are going back to it
The minute we can get it going!

West Breakwater Power Plant

By A. D. Williams

SYNOPSIS—A plant of unusual design installed by the Pennsylvania R.R. Co. to supply power for operating its ore dock and light and power to its yards and stations in the city of Cleveland.

In the design of this plant two classes of power were necessary in addition to both arc- and incandescent-lighting requirements: direct current at 250 volts for the operation of four 17-ton Hulett ore unloaders and a 15-ton ore bridge, and three-phase, 60-cycle, 220-volt power circuits for other requirements. Lighting is furnished from the direct-current supply to the unloaders, bridge and the power house; the yard is lighted from a mercury rectifier supplying 50 magnetite arc lamps, and 110-volt alternating current furnishes light to a machine and repair shop and supplements the yard lights.

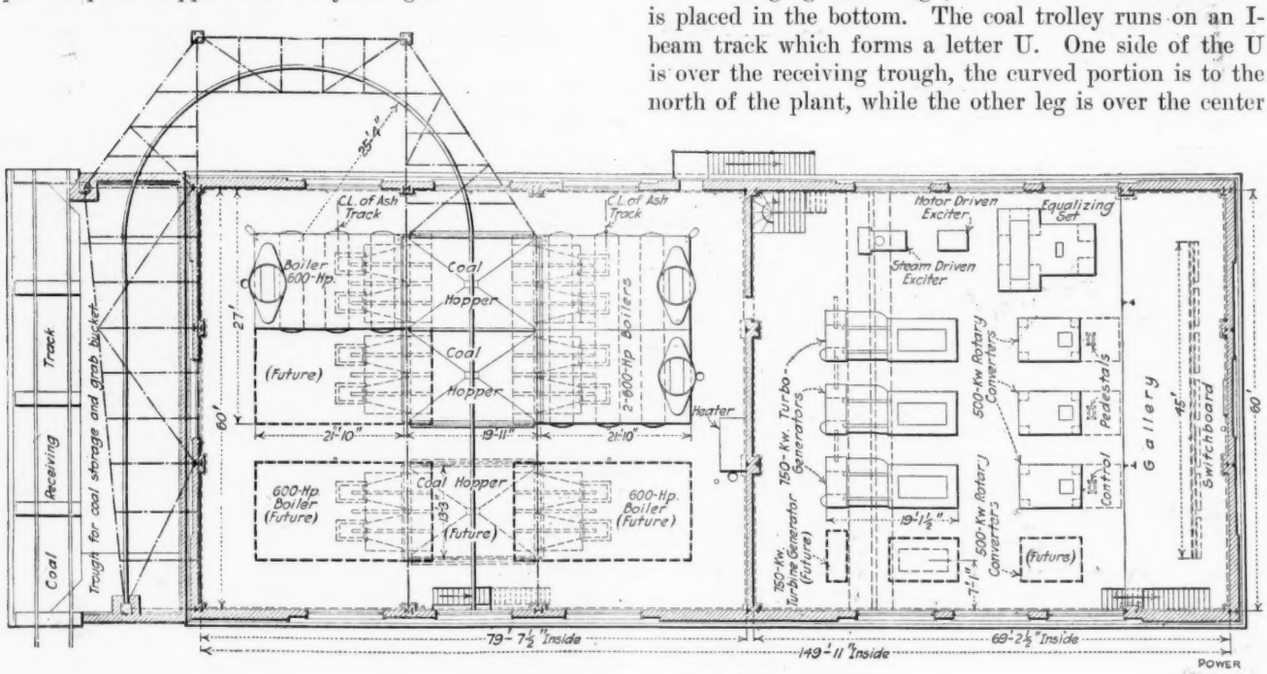


Fig. 1. Plan of Power Plant

Upon the west end of the new ore wharf of the company the plant is situated. The entire site of the wharf, covering about 40 acres, was originally under water, and it required about 1,000,000 cu.yd. of fill to bring the average grade up to about 4½ ft. above mean lake level. The basement floor excepting two trenches for railroad tracks, is six inches above this grade, or from two to six feet above the maximum and the minimum lake levels. The foundations for the building and machinery are carried by three hundred 30-ft. reinforced-concrete piles cast in vertical molds and after seasoning, driven through the fill. The basement structure, to the first-floor level, is of reinforced concrete and carries the boilers, the main machinery and the coal bunkers. The superstructure is of buff brick with cement copings, steel-framed windows and stone and cement trimmings, except the penthouse covering the coal bunkers and crusher, which is inclosed in cement mortar on metal lath.

The coal-handling arrangements are out of the ordinary. Coal is delivered in hopper-bottom cars which are run over and dumped into a track hopper about 60 ft. long on the west side of the building. The siding is 11 ft. above grade and extends along the side of the coal-receiving trough farthest from the building. This trough is so constructed that the coal will fall away from the receiving track into the portion of the trough covered by the monorail grab-bucket trolley, which runs on a track 72 ft. above grade; the bottom of the coal trough is 4 ft. below grade, making the total lift 76 ft. The trough gives a storage capacity of about 1500 tons, and two 100-ton bunkers serve each pair of boilers; provision has been made for a third bunker. The monorail coal trolley carries a three-ton grab-bucket and has a hoisting speed of 300 ft. per min. In order to prevent this heavy bucket from damaging the trough, an armor of old steel rails is placed in the bottom. The coal trolley runs on an I-beam track which forms a letter U. One side of the U is over the receiving trough, the curved portion is to the north of the plant, while the other leg is over the center of the boiler room (see Fig. 1). This track is supported on high skeleton steel masts outside of the building, and the portion over the boiler bunkers is in a penthouse protecting the trolley when not in use and also containing the motor-driven coal crusher.

This crusher is mounted upon a track and can be moved over either of the bunkers; it is fed through a hopper from the grab bucket and discharges by gravity into the bunker. These bunkers have hopper bottoms and outlets with gates arranged to feed the boilers on each side of the firing aisle through a breeches spout of square cross-section having inverted V-spreaders at their lower ends which cover the full length of the stoker hopper. At first, these breeches spouts clogged and required beating with a slicebar to bring down the coal. This was remedied by drilling holes, pointing upward, close to the points where the scaffolds seemed to form and tapping them. An air line was then run to each spout from the compressed-air supply and connected to a pipe nozzle in-

serted through the spout holes. A lever whistle valve with a cord led to a convenient location enables the fireman to break up any scaffolds that form, by the air blast with 100 lb. pressure. This method has proved satisfactory.

Each boiler is fired by a Roney stoker set in a 4-ft. "dutch oven" or coking arch. These stokers are driven by small Westinghouse engines supplied with steam from the auxiliary header. The exhaust from the engines is led to perforated pipes from which it blows into the fire bed on the stoker. Live steam is also brought to jets on these stokers and perforated water pipes for quenching the ashes are installed in each ashpit, along both sides and at the center wall. Fig. 8 shows a section through one of these stokers and the steam piping.

A feature of these stokers is their division into two sections with separate ashpits and doors for closing the ashpits and cutting down the draft when the boilers are banked. From the receiving hopper on the stoker the coal feeds down under a coking arch extending one-half the depth of the stoker grate. The rear half is covered by the regular arch gas baffle used in all Stirling boiler settings. Below the front portion of the grate there is a flat portion of the floor from which fine coal dropping through at this point may be recovered. The rear portion of the ashpit forms a chute, built in the

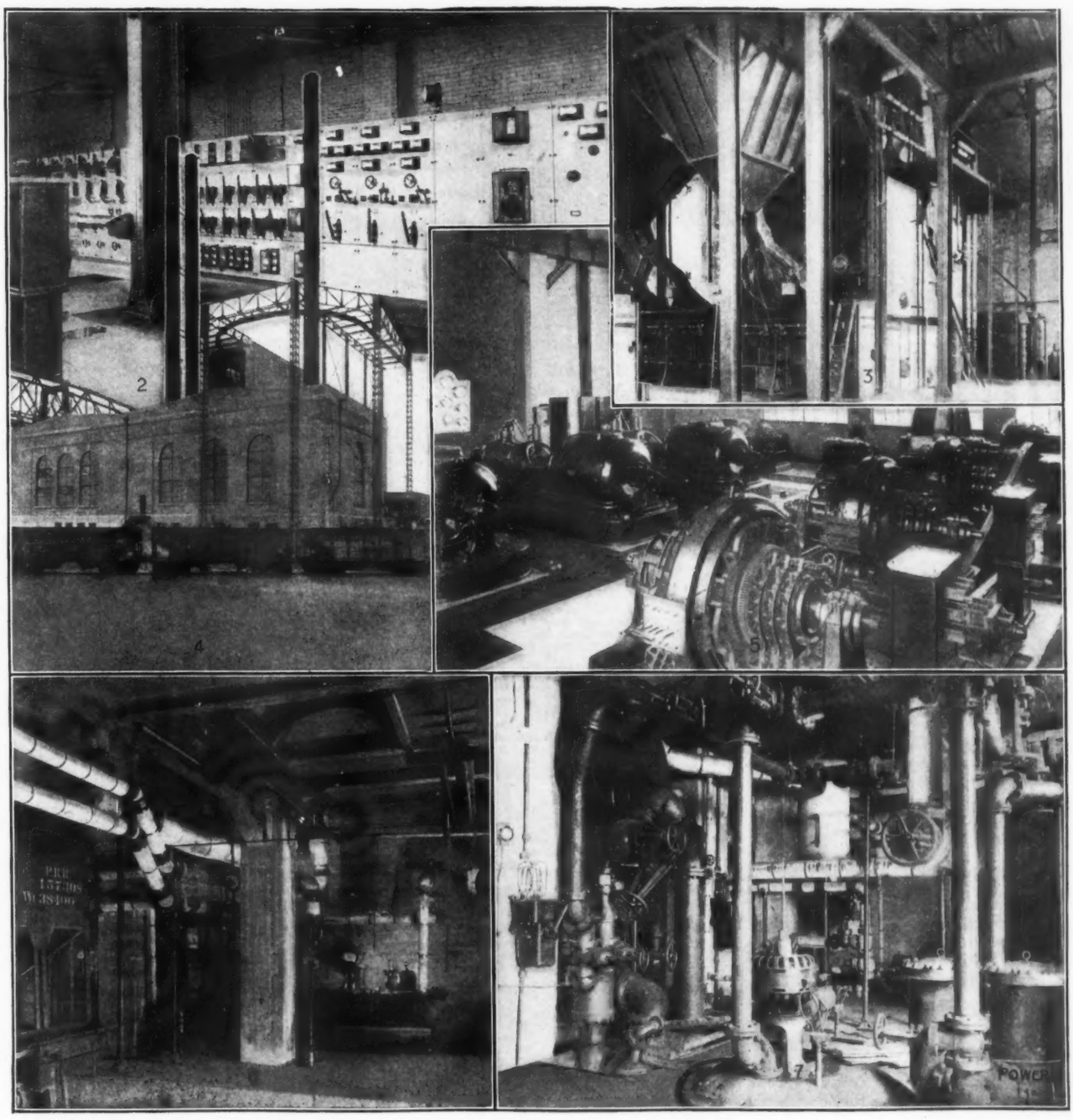


FIG. 2. SWITCHBOARD; FIG. 3. PART OF BOILER ROOM; FIG. 4. POWER HOUSE; FIG. 5. TURBINE ROOM; FIG. 6. BASEMENT BENEATH BOILERS, SHOWING MEANS FOR REMOVING ASHES; FIG. 7. PUMPS AND CONDENSERS

reinforced-concrete floor, which is closed by a flat gate sliding horizontally. A railroad track runs under each row of boilers and the ashes are discharged into steel hopper-bottom cars kept standing in the basement. This arrangement eliminates all ash-handling machinery and

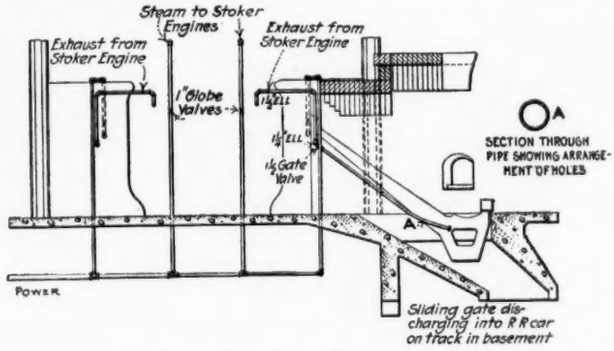


FIG. 8. SECTION THROUGH FURNACE

the loaded cars can be hauled out and dumped on parts of the wharf site where the fill has not yet been completed.

The boiler room contains three 600-hp. boilers with superheaters, each having an independent steel stack 66 in. in diameter and 125 ft. high. Two of the boilers are on the side adjoining the turbine room while the third is on the west side of the boiler room. The floor space is sufficient to install three additional boilers as soon as the demands warrant such extension.

There is a 2500-hp. feed-water heater in the boiler room and the exhaust steam from the feed and circulating-water pumps is led to this heater, which is supplied with water from the house-service system. From the heater, the feed water flows down to the basement to a pair of twin volute turbine-driven boiler-feed pumps controlled by pump governors. The water-supply to each boiler is controlled by feed-water regulators. The boiler-feed lines are in duplicate and normally operate together, but either may be shut down without interfering with the operation of the plant. There are meters in the feed lines.

Of the two steam headers, the main header is furnished with superheated steam but so connected that the superheaters can be short-circuited if desired; an auxiliary header is supplied direct from the drum of the boiler.

In the generating equipment, there are three 750-kv-a. turbogenerators driven by Parsons-type turbines at 3600 r.p.m. and provided with jet condensers. The generators deliver three-phase, 60-cycle current at 2200 volts and excitation is provided by a motor-driven and a turbine-driven exciter, each of 25-kw. capacity.

As previously stated, the unloaders and the ore bridge are operated by 250-volt direct-current motors. The motor equipment of the ore bridge comprises the following:

		Hp.
2	225-hp. hoisting and loading motors	450
2	75-hp. trolley traveling motors	150
2	75-hp. bridge traversing motors	150
2	25-hp. operating gates on loading hoppers	50
	Total	800

The nominal capacity of this bridge is 1000 tons per hr.; the hoisting speed of the 15-ton bucket, 175 ft. per min.; the trolley-travel speed, from 600 to 800 ft. per min., and the bridge travel 50 to 75 ft.

The four ore unloaders, having a capacity of from 35,000 to 40,000 tons per day when operated double turn, are equipped with 17-ton buckets and have the following motors on each machine:

		Hp.
1	300-hp. walking-beam hoist motor	300
1	100-hp. trolley motor	100
1	100-hp. bucket-closing and opening motor	100
1	25-hp. bucket-rotating motor	25
1	150-hp. receiving hopper operating motor	150
1	150-hp. larry car hauling motor	150
1	35-hp. larry car gate operating motor	35
	Total	860

PRINCIPAL EQUIPMENT OF WEST BREAKWATER POWER PLANT, CLEVELAND, OHIO

No.	Equipment	Kind	Size	Use	Operating Conditions	Maker
3	Boilers	Stirling water-tube	600 hp.	Main units	150 lb. pressure, 100° superheat	Babcock & Wilcox Co.
3	Stokers	Roney inclined grate	110 sq.ft.		Ohio screenings	Westinghouse Mach. Co.
2	Engines	Vertical, single-acting	4½x4 in.	Stoker drive	150 lb. pressure	Westinghouse Mach. Co.
2	Pumps	Centrifugal 2-stage	350 gal. per min.	Boiler feed	438 ft. head, 3100 r.p.m.	De Laval Steam Turbine Co.
2	Turbines	Reaction	40 hp.	Drive boiler feed pump	150 lb. pressure, non-condensing	De Laval Steam Turbine Co.
1	Coal hoist	Monorail trolley	2.5 tons, 300 ft. per min.	Receiving trough to bunkers	Grab bucket, 66 ft. hoist	Sprague Elec. Co.
1	Coal crusher	2 roll				
1	Feed water heater	Open	2500 hp.	Boiler feed heater	Exhaust from auxiliaries	Harrison Safety Boiler Works.
1	Air compressor	Single stage	12½x12 in.	Railroad switches and house service	100 lb. pressure	Ingersoll-Rand Co.
1	Motor	Induction	75 hp.	Air compressor drive	3 phase, 60 cycles, 220 volts	Westinghouse E. & M. Co.
3	Generators	Alternating current	750 kv.a.	Main units	3 phase, 60 cycles, 2300 volts, 3600 r.p.m., 98% regulation	Allis-Chalmers Co.
3	Turbines	Horizontal reaction	750 kw.	Main unit	150 lb. pressure. 100° superheat, 3600 r.p.m.	Allis-Chalmers Co.
3	Condensers	Jet		On main units	28-in. vacuum	Allis-Chalmers Co.
3	Turbines	Horizontal reaction	50 hp.	Drives circulating water and air pump	150 lb. pressure, non-condensing	Kerr Turbine Co.
1	Generator	Direct current	25 kw.	Exciter	208 amp., 120 volts, 2400 r.p.m.	Allis-Chalmers Co.
1	Turbine	Horizontal reaction	25 kw.	Drive exciter	150 lb. pressure, non-condensing	Allis-Chalmers Co.
1	Generator	Direct current	25 kw.	Exciter	208 amp., 120 volts, 850 r.p.m.	Allis-Chalmers Co.
1	Motor	Induction	34 hp.	Exciter drive	3 phase, 60 cycles, 2200 volts	Allis-Chalmers Co.
3	Rotary converters	6 phase, 60 cycle	600 kw.	A.C.-D.C. transformation	175 volts A.C. to 250 volts D. C., 2000 amp.	Westinghouse E. & M. Co.
3	Transformers	Oil insulated water cooled	550 kv.a.	Rotary converters	3 phase, 60 cycles, 2200 volts to 6 phase, 175 v.	Westinghouse E. & M. Co.
1	Equalizer	Flywheel motor-generator	500 kw., 25,000 hp.-sec.	Peak load on direct current circuits	250 volts, 2000 amp., floats on line 600 to 720 r.p.m.	Westinghouse E. & M. Co.
1	Switchboard	Alternating and direct current	21 panels	Power control		Ft. Wayne Wks., General E. Co.
2	Rectifier sets		50 lamp	Arc lamps D. C. magnetite		General Electric Co.
2	Pumps	Duplex reciprocating	3½x2½x3 in.	Main unit lubrication	150 lb. pressure, non-condensing	T. M. Prescott Co.
3	Transformers	Oil insulated	5 kw.	Lighting	Delta-delta connections, 2200 volts, 110 volts	Pittsburgh Transformer Co.
3	Transformers	Oil insulated	40 kw.	Power	Delta-delta connection, 2200 volts to 220 volts	Pittsburgh Transformer Co.
1	Strainer	Elliot twin	5 in.	Water service		Elliot Co.
2	Pumps	Vertical twin volute	5 in., 500 gal. per min.	Water service	30 ft. head, 1133 r.p.m.	Watson-Stillman Co.
2	Motors	Induction vertical shaft	15 hp.	Drive service pumps	3 phase, 60 cycle, 1133 r.p.m.	Westinghouse E. & M. Co.
1	Crane	Hand traveler	15 ton	Turbine room		Whiting Foundry Equipment Co.
	Water meters			On boiler feed lines		Henry R. Worthington
	Piping and valves	All				Pittsburgh Valve, Foundry & Equipment Co.

In addition, direct current is supplied to a battery of narrow-gage electric poling locomotives, used to spot cars under the unloaders when they discharge cargo direct into the cars.

The direct-current peak load from the four unloaders will approximate 2000 kw. and that from the ore bridge is about 1600 kw. The fluctuations are rapid, swings of from 1200 to 1500 kw. frequently occurring at intervals of from 15 to 30 seconds. Three 600-kw. rotary transformers supply this direct-current load and to smooth out the violent swings a 500-kw. flywheel motor-generator set is kept floating on the line. This machine has three bearings and the armature shaft carries, in addition, a 20-ton flywheel built up of heavy steel plates. Windage losses are reduced by inclosing the wheel in a steel-plate housing. Under normal conditions, the speed of this machine ranges from 600 to 720 r.p.m., acting as a motor, absorbing power at the higher speeds and restoring power to the line as the speed drops. A liquid field regulator automatically regulates the speed so that the load on the rotary transformers is held within 10 per cent. variation. The storage power of the flywheel is approximately 25,000 hp.-sec. and the machine is designed to carry a 100 per cent. overload 10 sec. out of every 2 minutes.

Design of Ashpits

By T. A. Marsh

SYNOPSIS—Features to be observed in building ashpits. How to figure their capacity. Faults and merits of typical designs.

There are several fundamental principles to consider in connection with any designs or recommendations made for ashpits. As discussed in this article the considerations apply strictly to chain grates, but the general principles hold for practically every kind of stoking apparatus. The features to be observed are:

1. The pits should be of ample capacity.
2. The removal of ash from the pits should be accomplished by a minimum amount of labor.
3. The design should be such that the maintenance cost of valves and doors is minimum.

These features also hold true regardless of the type of carrier or conveyor which disposes of the ashes after they are removed from the pits, although the type of carrier is one of the items which must govern the kind of pit adopted.

Capacity of Ashpit

It is desirable to design ashpits of a sufficient capacity to accommodate the ashes from an 18- or 20-hr. run. Such pits avoid the necessity of a night shift for ash handling and insure the stoker equipment against those ills consequent to permitting ash and clinker to accumulate up to the stoker mechanism.

While it is seldom possible to obtain pits of such ample capacity, with the modern ideas and proportions of designs, pits having capacities of 12 to 14 hr. are usually obtainable. The latter, while not quite safe from an operating standpoint, do away with the night ash-handling shift, providing the ash-disposing system is ample to perform this work in the day time and if the day shift leaves the ashpits clean when it goes off duty.

The problem of providing sufficient capacity is simple. Determine the maximum amount of fuel that can be burned on the grate. This is a product of the pounds of coal burnable per square foot of grate surface per hour and the number of square feet of grate surface. The contractor's specifications usually state both of these items. In the absence of such specifications or guarantees a study of the draft provision will give a basis on which to estimate the combustion rate, as the handbooks and catalogs of the boiler and stoker companies have information regarding the combustion rates obtainable with any given draft.

It is desirable to use the maximum rate on the assumption that some day it will be necessary to operate for a considerable period at that rate regardless of the station's supposed requirements and the designer's intentions. The maximum percentage of ash or refuse should be then considered and ample allowance made for the lowest grade of fuel in the market. The product of the percentage of refuse and the hourly fuel consumption will be the number of pounds of ash and refuse obtained per hour.

A study of average test results with the fuels under consideration will serve as a guide to the percentage of ash and refuse to use in the foregoing calculations. With the high-grade fuels of the Atlantic seaboard it would be safe to provide for refuse to the amount of 10 per cent. of the fuel, with coals of the Pittsburgh district 15 per cent. and of Illinois and Indiana 20 per cent. Coals of Iowa and some Southwestern localities contain as high as 40 per cent. of ash by analysis.

A cubic foot of ash weighs from 40 to 50 lb., depending upon its quality. For safety in allowing ample proportions, 40 lb. should be used. In this way the capacity in cubic feet necessary to accommodate one hour's ash is determined, and an analysis of any proposed design can at once be made from a standpoint of suitable capacity; or a pit can be proportioned to hold the ash and refuse for a given period of operation.

Ease of Cleaning

It is important that the ashes be removed from the pits without unusually hard and disagreeable labor, otherwise the pits will not be cleaned regularly and properly. It will be difficult to retain laborers for this work and the cost of removal will be high, to say nothing of damage to the ashpits and stokers if the pits are habitually permitted to become overfilled.

From this second standpoint the design of pits is largely one of motion study and of the method used in removing ash. From these considerations it is desirable to have the discharge door at a convenient height for the operator to use a hoe or a shovel, whichever the particular design may call for. It is better to have this door too low rather than too high.

Pits must also be so designed that there is ample room

to use a hoe or shovel. Some pits necessitate hand shoveling, and when this design is used, there should be plenty of room to use a shovel. In other designs the ashes are hoed forward, but the distance they are to be drawn must not be too long (8 ft. is about the maximum); there must be clearance for the hoe as the ashes are dragged forward.

Where valves are used on ash hoppers, see that the valves can be opened and closed readily from the floor and while the ash car is under the valve. Moreover, such designs should provide means for inspecting the hoppers to see that the ashes have been thoroughly discharged and for readily poking down any lodged ash or clinker without danger to the operator.

Pits that are relatively small but are accessible and easily cleaned give better results than large pits involving heavy labor and perhaps some danger.

Maintenance

The maintenance cost of ashpits is often high, particularly where there is considerable clinker and where the sulphur content is high. It is desirable from an operating standpoint, and usually from the maintenance point, to provide ashpits with a water-sprinkler system to quench the ashes. However, if there is exposed steelwork the corrosion will be rapid and the maintenance cost will go up.

Concrete- or brick-lined pits are most desirable and those pits which do not permit ash and clinkers to pile against the discharge doors or valves give the best all-around results. The reasons for this are that when ashes are piled against the discharge doors, no matter how well these doors are made, there will be a considerable air leakage, and this air drawing through the ash will continue the combustion of any unconsumed fuel. This action results in a mass of clinkers in the ashpit or hopper which is difficult and perhaps dangerous to remove. Moreover, the combustion against the discharge doors results in the rapid warping and burning of the metal parts. Many types of stoker should have tight ashpits which it is practically impossible to maintain after a few weeks' operations with pits of a design permitting ash to accumulate against the discharge doors.

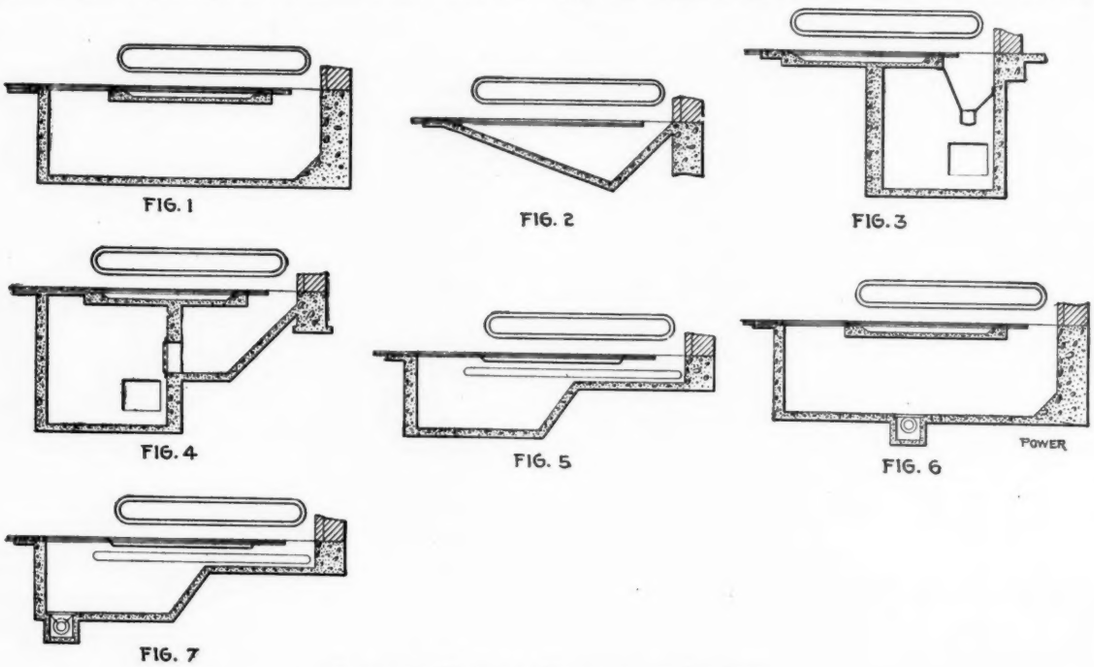
Bearing directly upon the cost of maintenance of ashpits is their accessibility. Some are provided with long chutes or small valves or doors which are inaccessible and the cost of repairing the pits or relining them is consequently higher than normally.

Typical Designs

To make the discussion specific, a number of ashpit designs are shown and attention is called to their faults or merits. They by no means cover the field but they are somewhat typical and serve to represent certain principles.

Small plants of 1000 hp. and less seldom have any but manual means for handling ashes, and ashpits of the designs shown in Figs. 1 and 2 are usually employed.

Fig. 1 represents a plain pit of rectangular section and has in its favor cheap construction. The length of this type necessitates that the ashes be hoed forward and then be shoveled out into a barrow or car. Such pits should be used only in plants operating four or less boilers, as any excess will warrant a more elaborate system of ash removal. An analysis of this design indicates that it can seldom be made of ample capacity; the removal of ash is difficult but the maintenance is extremely low.



Showing Several Designs of Ashpits

Fig. 2 represents a sloping pit. Such pits are used where it is impossible to excavate to a proper depth, but the results are usually unsatisfactory. The design is a failure from the capacity standpoint and also largely from the point of ash removal.

Fig. 3 indicates an ash hopper. These can be made of various designs and are frequently used in the largest stations. It is preferable to have such hoppers lined with firebrick. They should have large valves, preferably 24 or 30 in. square, as this is a type in which the ash clinkers against the discharge valve. Some designs have been made with diverging sides so that the ash and clinker cannot lodge. This pit indicates that it can be

made of ample capacity and that if care be taken in the design the removal of ash is not difficult, but its upkeep is against it; in addition, it is difficult to inspect and to repair.

The pit shown in Fig. 4 is a desirable design and can be made to meet the proper requirements better than any of the others discussed. Ample capacity is provided and the ashes are retained on a horizontal brick-lined or concrete floor and are not in contact with the metal discharge door. There is no tendency, therefore, for the door to warp and become leaky, and the ash itself remains in the same finely divided state in which it was discharged from the grate.

Ashes are removed by a hoe from this pit, and the designer should make sure that the horizontal distance of the ashpit floor is not over 8 ft. He should also see that there is fully 8 ft. clearance in front of the door for the handle of the hoe when withdrawn. These pits when 6 ft. wide or under should have one 24-in. square cast-iron door; when in excess of this width two doors of this size should be provided.

This design has the three features of capacity, ease of ash removal and low maintenance. It can be modified to permit shoveling from the floor in cases where the head room is slight or modified to permit hoeing into a railway car where basements are designed along such lines.

Sometimes due to soil conditions, to pipe lines or to other local conditions, it is undesirable to excavate for an ashpit in front of the bridge-wall and the pit has to be put forward in front of the boilers. This necessitates the use of an ash drag or conveyor, as shown by Fig. 5. The mechanism for such a device is simple and the results obtained are satisfactory. The arrangement costs more than the plain pit, Fig. 1, but requires less labor for ash removal, although this is partially offset by the additional labor consequent to an additional piece of conveying machinery. The capacity of such a pit is low, but the danger of overfilling it is removed, the ashes being drawn forward where they can do no harm.

Special types of ash-conveying machinery improve some of the designs materially, for instance, the plain pit shown in Fig. 1. When provided with a steam-jet system or a pneumatic ash-handling system, Fig. 6, it becomes a desirable design as to ease of ash removal, although the capacity of the pit is still limited.

The hopper arrangement, Fig. 3, lends itself to almost any type of conveying machinery or car system, as does that shown in Fig. 4.

The design shown in Fig. 5 can be improved by using the pneumatic ash-handling system or a steam-jet conveyor, Fig. 7.

The foregoing considerations cover only the general principles involved and specific cases require special design. However, their application may serve as a guide in laying out this feature of the power plant.

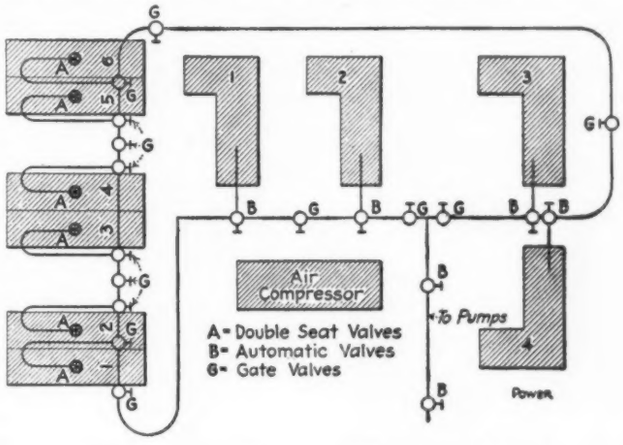
What the Engineer Can Do—Among the functions of the operating engineer none is more important than advising the plant owner in the purchase of new equipment. The more able an engineer is in selecting the best apparatus, the greater his value to his employer and the more likely that the right types of machines go into the plant. Today the plant owner expects more of his engineer than doing routine operating work, and often studying machinery contracts, specifications and correspondence in connection with former purchases has well repaid the engineer.

Nonreturn Valves on Engine Steam Pipes

By J. C. Hawkins

Nearly all states and cities with boiler-inspection laws require that where two or more boilers are connected to a common header and the pressure is over 10 lb., there shall be two valves on the branch to each boiler, one of which shall be nonreturn. This is to lessen the danger of employees being scalded by escaping steam when a tube blows out, when any other accident happens to prevent a shutdown of the rest of the plant, and to make it impossible to turn steam into a cold boiler whether it is standing idle or undergoing repairs.

Although these rules apply to the boilers only, they should be applied to the main steam line. Frequently a steam pipe bursts or an engine is wrecked, causing loss of life and severe damage that would have been much less with the proper installation of automatic valves. As boilers are often set, there are only a few feet between their tops and the ceiling. The same may be said of the main steam line. If a tube blows out, a valve or fitting on the steam line breaks or the engine is wrecked, it is usually impossible to get to the valves on the main line to close them until the steam is off the entire plant; even if the valves can be reached, they usually have a long thread and turn hard, requiring considerable time for closing. For this reason the nonreturn valve, as usually installed, protects the boiler to some extent, but no other part of the plant; neither does it protect the boiler from having all of the steam and a greater part of the water drawn through a break in the steam line. Protection of the boiler is all that the law requires, but it is only a part of what is really desired.



Boiler-Piping Diagram, Showing Valves

Take, for instance, a plant with the steam line arranged on the loop system as shown in the sketch. There are several boilers, engines and pumps. The boiler laws require that a nonreturn valve be placed on the boiler branch near the boiler as at *A*. With two or more on the line, a tube blowout or other accident will cause valve *A* on the disabled boiler to close, thereby preventing the steam from escaping from the other boilers or header. If, however, a fitting or valve in any part of the steam line breaks or an engine is wrecked, this valve is useless, and the steam in all the boilers may escape. This valve should be of the compound or double-seat type, and so balanced that a sudden draft of steam in either direction will cause it to close.

In case of accident to the main line, this would cause every boiler to be cut out automatically and only the steam in the header would escape. The sudden rise of pressure in the boilers due to closing the steam outlet while there was a heavy fire would be taken care of by the safety valves.

These automatic valves contain several parts which must work freely if the valve is to function, and usually it has levers or springs on the outside. As any of these parts may get out of order, the valve should be placed at the boiler with a gate valve between it and the header so that whenever it needs attention, it is only necessary to cut the boiler out. These valves should always be provided with means of indicating whether the valve is open or closed. They must be so placed that no water pocket will be formed. In cutting a boiler into service the gate valve at the header end should be opened first by equalizing the pressure through its bypass; then the stem of the automatic valve should be turned up. This will permit the boiler to be automatically cut into service when the pressure reaches the desired amount.

Automatic engine stops are often used to quickly close the throttle if the engine overspeeds, but many times accidents are caused by water in the cylinders.

To prevent the escape of steam an automatic valve should be placed at the engine branch as shown at *B*. The location of the valves, which usually are of the outside screw-and-yoke type, is such that they could not be reached in case of accident until the steam is all blown off. The system of piping also contains a large volume of steam, which in escaping may do the goods considerable damage, as in a department store. With an automatic valve at this point, a sudden draft of steam would cause that particular line to be cut out without interfering with the operation of the rest of the plant. This valve would necessarily have to close in the direction which the steam is flowing, and be nicely adjusted to remain operative and yet not close with a sudden increase in load on the engine.

Some of these valves are so arranged that they may be operated by a solenoid or by steam or air pressure and be closed from any part of the plant. If so arranged, they would act as an engine stop, as well as an automatic valve.

Maxim Safety-Valve Silencer

A recent development on the principle of the Maxim silencer is a device for eliminating the noise of blowing safety valves and of the boiler blowoff when fitted to the outlets of either.

The steam is led into passageways of increasing area, fitted with sound traps to prevent the passage of sound waves along with the steam. By making these passageways of sufficient area the velocity of the steam is brought down to a point where the noise of its escape to the air is not objectionable.

FIG. 1. MAXIM SILENCER FOR STEAM SAFETY VALVE

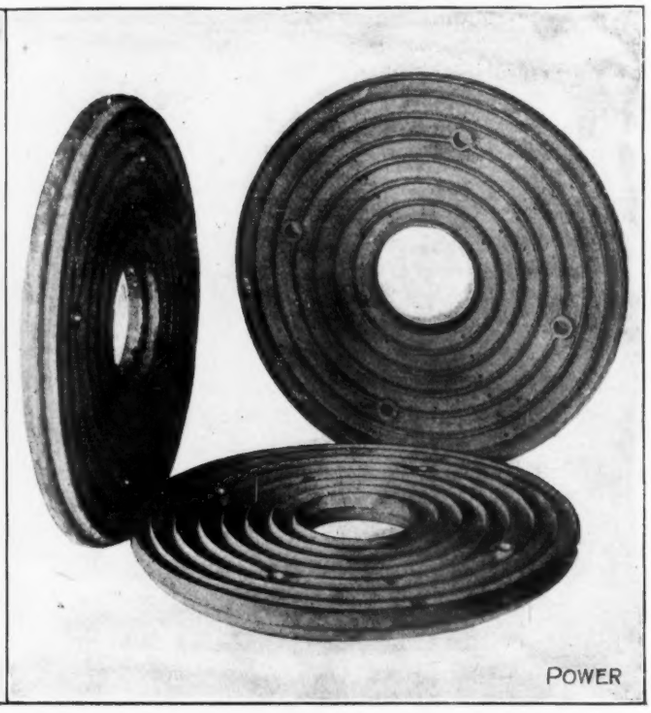


FIG. 2. DETAILS OF DESIGN OF SILENCING CHAMBER

In the safety-valve silencer, Fig. 1, the final outlet area is nearly 20 times the area of the safety valve, and the velocity of the steam is not only proportionately lower by virtue of this area, but also on account of the cooling and the reduction of the volume.

An interesting feature of the silencer is the noise trap, Fig. 2, which provides an endless channel in which the sound waves circulate until they disappear. The traps are so arranged that the escape of the sound waves from trap to trap multiplies the frequency of the wave. This is continued until the frequency is carried above audibility and is also smoothed over so as to secure approximate uniformity of one sound wave with another.

The silencer for the boiler blowoff is constructed on similar lines to that used for the safety valve, but it has a receptacle for the collection of solid matter, which avoids abrasion and wear of the internal surfaces. The Maxim Silencer Co., Hartford, Conn., are the manufacturers.

Locating Faults in Direct-Current Armatures--III

By F. A. Annett

SYNOPSIS—Testing for short-circuits, open circuits and cross-connected coils by means of a millivoltmeter and a low voltage current.

There are several ways of testing for defects in armatures, one of the most common being by the use of a millivoltmeter or an ammeter without a shunt, as in Fig. 1. An instrument having a permanent magnetic movement is preferable, as this type is usually more sensitive than others, and will read only with the current flowing through in a certain direction; otherwise, the needle will deflect back off the scale. It is especially desirable in locating cross-connected coils, as will be seen later. In making the test, first pass through the armature a direct current of such strength as will give ample deflection on the instrument, preferably about half way across the scale. This current may be supplied from any low-voltage source, the amount passing through the armature under test being regulated by a rheostat, or a bank of lamps, as shown. The testing instrument should be connected to three or four pairs of adjacent segments to get an average reading, and then proceed systematically around the commutator, testing from bar to bar.

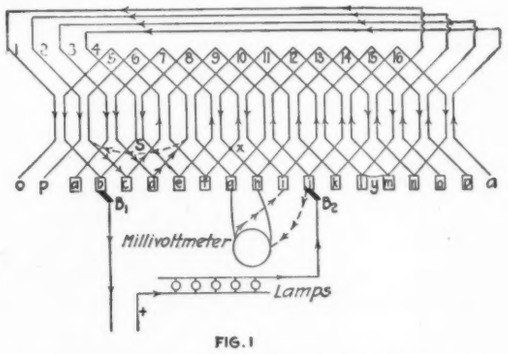


FIG. 1

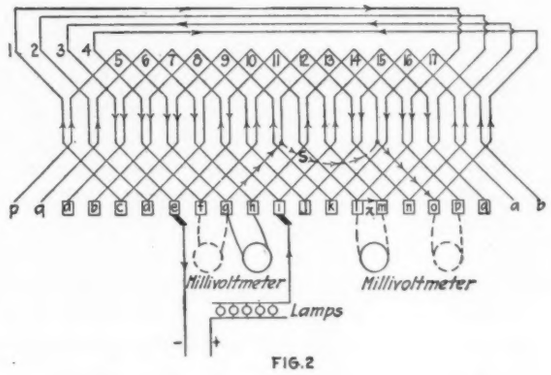


FIG. 2

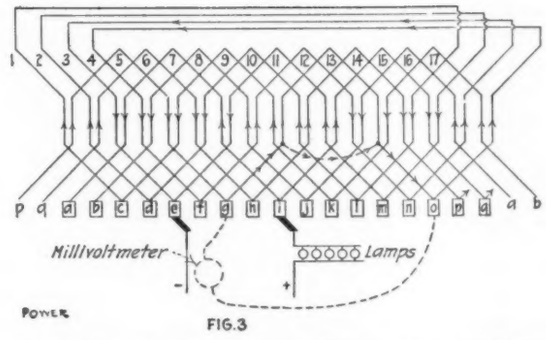


FIG. 3

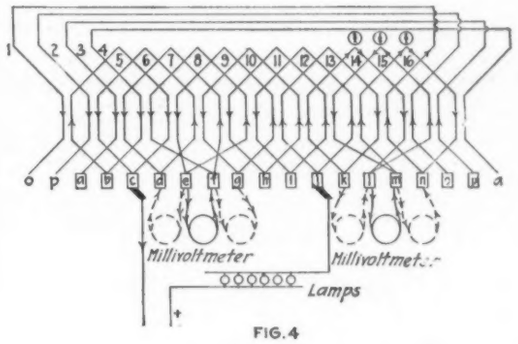


FIG. 4

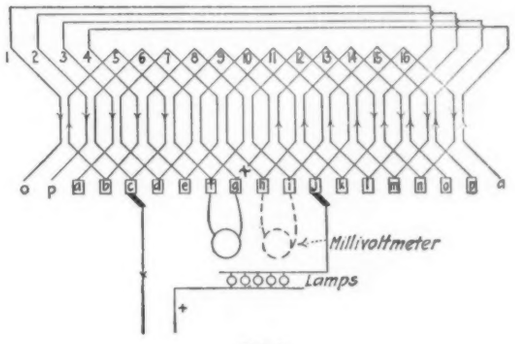


FIG. 5

Armature Windings, Showing How to Locate Short-Circuits and Cross-Connected Coils

The effect obtained from a short-circuited coil or a short-circuit between commutator segments will be understood by reference to Fig. 1. In tracing out the current from brush B_2 around through the armature winding to brush B_1, it will be seen that the short-circuit at x, between coils 8 and 11, shunts coils 9 and 10; therefore no current will flow through them. Also, coil 6 is represented short-circuited at s. This will cut out all or part of coil 6, and the voltage drop across it will be less than across the good coils.

If the instrument is connected to segments i and j, it will give normal deflection, providing everything has been adjusted properly; likewise, when connected to segments h and i. When connected to segments g and h or f and g, however, it will not show any deflection, as no current is flowing through coils 9 and 10; hence there is no voltage drop across them. This shows that coils 9 and 10 are short-circuited.

If there is not good contact at x, some current will flow in coils 9 and 10, depending upon the resistance at x, which the instrument will indicate by a reduced deflection. After passing segments f, g and h, the instrument will give normal reading until connected to segments c and d, where it will again give a reduced deflection, indicating that coil 6 is short-circuited. This would again

occur between segments *l* and *m*, where the short-circuit is not in the coil but between the segments as represented by *y*. When a short-circuit is thus indicated, in order to find out whether it is in the coil or the commutator, it will be necessary to disconnect the coil leads from the segments between which the fault was located and test across them with a lamp. In this case it would not light between *c* and *d*, indicating that the defect is in the coil, which may be removed and repaired, or repaired as explained in connection with Fig. 2, part 2 (Nov. 17 issue). On the other hand, if a test is made across segments *l* and *m* with the coil leads disconnected, the lamp will light, which would indicate a short-circuit between the commutator bars. This is usually caused either by solder getting on the back end of the commutator or the mica carbonizing between the segments.

After a commutator has been trued up in a lathe, it should be carefully inspected before testing, to see that the tool has not drawn the copper from one segment to the next across the mica, thus causing a short-circuit. An easy way to make this inspection is to moisten a piece of cloth or waste with oil and hold it on the commutator while turning in the lathe. This turns the segments a deep copper color and the mica black; consequently, if at any point the copper has been drawn from one segment to another, it will be readily detected.

In an armature that is series (wave) wound, as in Fig. 2, a little more consideration is necessary to locate the defective coil. Coil 13 is shown short-circuited by the dotted line *s;* also a short-circuit is shown between segments *l* and *m* at *x*. It will be seen by tracing out the circuit that the short-circuit between segments *l* and *m* cuts out coils 2 and 10, or a coil for each pair of poles. This is true for any number of poles; in a six-pole machine, a short between commutator bars will short-circuit a group of three coils located 120 deg. apart in the winding; for an eight-pole winding, four coils 90 deg. apart, etc.

If the testing instrument is connected to segments *g* and *h*, it will read the drop across coils 14 and 5, which should give a normal deflection. Again, connecting it to *f* and *g* will give the drop across coils 13 and 4. Coil 13 is short-circuited at *s*; therefore the drop across it will be less than across a good coil, and the deflection on the instrument will be less than normal, indicating a short-circuited coil. When the instrument is connected to segments *o* and *p*, it will again read the same as at *f* and *g*, indicating the other terminal of the defective coil.

The exact location of the faulty coil may now be determined by connecting one terminal of the instrument to a segment between which the defective coil was indicated, such as at *g*, Fig. 3, and testing to the segments in the other location of the fault, such as *o* and *p*. When connected to *o* it will be across the terminals of the faulty coil. This will be indicated by a very low reading or no reading at all. A reading taken across *l* and *m*, Fig. 2, will be very low, and will indicate a short-circuit between the segments at that point.

The indications that will be obtained on a millivoltmeter or ammeter for a cross-connected coil will be understood by referring to Fig. 4. The instrument is shown connected in three positions at segments *d*, *e*, *f* and *g*, with the coil leads to segments *e* and *f* interchanged. When the testing instrument is connected to *d* and *e*, it will give a deflection double that of normal. By tracing out the circuit from *e* to *d*, it will be seen that the current passes through two coils in series, which will cause a double voltage drop between these segments. If the testing instrument is connected to segments *e* and *f*, the current will flow through it in the opposite direction, as indicated by the arrowheads, and the needle will deflect backward off the scale. In taking a reading across segments *f* and *g*, a deflection will be obtained the same as at *d* and *e*. If the leads to *e* and *f* are now interchanged, and another reading is taken across these segments, a normal deflection will be obtained.

The leads to coil 15 are shown crossed at segments *l* and *m*. If readings are taken at positions *kl*, *lm* and *mn*, the instrument will give a normal reading in each case, reading the same across the cross-connected coil as the others; therefore a coil connected this way cannot be located by this method. A practical way of locating a coil connected in this manner is to explore with a compass the polarity of the magnetism from coil to coil at the back end of the armature. A cross-connected coil will give a reversed deflection, as shown at coil 15. The compass should be held slightly above the level of the coil.

Open-circuited coils may be located in the same way as explained for short-circuited coils, only the defective coil will be indicated by a full scale deflection on the instrument, as will be understood by referring to Fig. 5. Coil 9 is shown open-circuited at *x*, and if the winding is connected as shown, current will flow from segment *j* through the part of the winding indicated by the arrow-heads, but cannot flow through the coils left blank, for the circuit is open at *x*. Taking readings between *k* and *l*, *l* and *m*, etc., a normal deflection would be indicated, but if the instrument is connected to *i* and *h*, it will not read, for there is no current flowing through coil 11; therefore there is no voltage drop across its terminals; likewise across coil 10. However, when the instrument is connected to segments *f* and *g*, it bridges the break in coil 9 and there will be an abnormal deflection of the needle. If the coil leads are not properly soldered to the commutator segments, a comparatively high resistance exists in the connection. This will be indicated on the instrument by a deflection higher than normal.

This method of testing can also be used to locate a grounded coil in the armature winding; but, instead of testing from bar to bar, one terminal of the instrument is connected to the shaft and with the other terminal a bar-to-bar test is made on the commutator, the location of the grounded coil being indicated by a very low reading on the instrument. After the two segments that give the lowest reading have been located, disconnect the coil terminals from them and test for the ground with a lamp. If the winding is parallel-connected, the two segments to which the grounded coil is connected will be located together; if series-connected, they will be located two pole spaces apart.

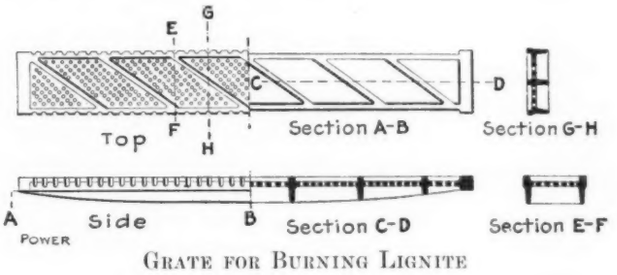
To distinguish between a parallel- and a series-connected armature winding, first note the center of the coils at the back end of the armature. If the leads to the commutator are in the same direction as the back ends of the coil—that is, swung in toward the center—the winding is parallel-connected. If the leads swing around the armature away from the center of the coil, the winding is series-connected. This will be readily understood by comparing Figs. 1 and 2.

The location of the testing-current connections to the

commutator must not be overlooked. If the armature is parallel-connected, the connections should be 180 deg. apart, whereas in series-connected armatures the connection should be one pole space apart, namely, 90 deg. on a four-pole machine, 60 deg. on a six-pole machine, etc.

Directions for Burning Lignite

That there is estimated to be more than thirty billion tons of lignite in Texas, this deposit covering an area of more than 60,000 square miles, is directing more and more attention to its use in boilers. This fuel is already extensively used in manufacturing plants. Dr.



GRATE FOR BURNING LIGNITE

William B. Philips, of Austin, director of the Bureau of Economic Geology and Technology of the University of Texas, has recently investigated the sources of lignite and its commercial use and gives his conclusions in a recent report.

Eight years ago it was the custom for the miners to load nothing but mine-run lignite, but since the introduction of a grate adapted to burn lignite screenings, this grade is sold at from fifty to sixty cents a ton, f.o.b. mines.

This grate, shown herewith, is like the ordinary grate, being approximately rectangular in cross-section and wider at the top than at the bottom. On its top face are marginal and transverse ribs or partitions, forming fuel pockets adapted to retain fine fuel. On its bottom face are recesses forming air pockets. These fuel pockets are from one-half to five-eighths of an inch deep and are connected with the air pockets by tapered ventilating holes, largest at their lower ends, being about three-eighths of an inch in diameter at the top and 50 per cent. larger at the bottom. The tapering form of the ventilating holes tends to cause a discharge of the air in jets into the fuel.

In ordinary grates, especially where a forced or induced draft is used, the air rushes through the weakest places in the fire. With this grate the individual air pockets underneath prevent the air from rushing past some of the ventilating holes and overcharging others. These air pockets form sources of supply to the separate groups of ventilating holes and cause an even distribution of the air to the fuel pockets in the top of the bar throughout the grate surface. A steam blower is used with these grates.

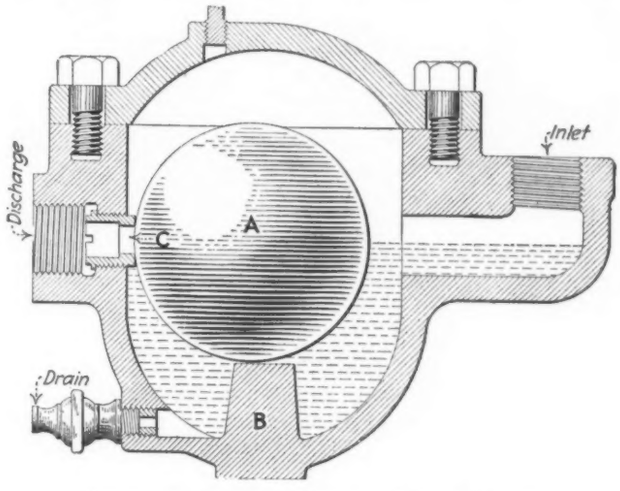
Much lignite is now fired by hand, and while this method unquestionably gives good results when proper care is taken, the stoker seems to be necessary for large establishments. There are no difficult obstacles to be overcome. The main points to consider are that lignite is a fuel which parts with its volatile combustible matter more quickly than does ordinary bituminous coal and that the fixed carbon is not of a coking nature. This means that a large quantity of air must be supplied within a short time after the fuel begins to part with its volatile combustible matter and is supplied at the requisite points. The smoke must be prevented from forming, for it is difficult to handle it afterwards. The fixed carbon will take care of itself, if prevented from falling through the interstices of the grate; it is the volatile combustible matter that has to be cared for.

It does not appear that there are greater variations in the composition of lignites than in the coals with which they are to compete, so that a stoker installation successful with one lignite should be capable of burning any other under comparable conditions.

Brown Steam Trap

It would be difficult to design a steam trap more simple than the Brown, which consists of a body, a discharge orifice and a float. The sectional view of the trap shows the interior construction. The float *A* is tested to 300 lb. pressure and rests on the projection *B*. When the trap has discharged the float seats against the discharge orifice *C*.

When condensate enters the trap through the inlet the ball floats, opening the discharge orifice and permitting a constant discharge of water without loss of steam.



SECTION THROUGH BROWN STEAM TRAP

There is also a constant discharge of air and the trap does not become air bound.

This trap, which is manufactured by the D. G. C. Valve Co., Fuller Bldg., New York City, has no working parts and but one moving part, the rolling ball, which seats in a new place each time and cannot get out of order. The trap will handle water against any back pressure less than the pressure at the trap. It is made in ¾-, 1- and 1¼-in. size, with 700, 1000 and 1700 lb. of water per hour capacity respectively.

Labeling of Incandescent Lamps—Why are incandescent lamps usually labeled with three voltages, such as 110, 112 and 114 volts?

H. E.

To indicate the voltages for which they are adapted. For obtaining full efficiency and candlepower they should be burned at the highest voltage indicated. At the next lower voltage they will burn with a somewhat decreased efficiency but will have a longer life. At the lowest voltage the efficiency will be still less and the candlepower will be about 80 per cent. normal, but the life of the lamp will be almost double that at the highest voltage.

The Franklin Flue-Gas Analyzer

To overcome the troubles experienced with Orsat apparatus having pinch or glass cocks, Frank Duemler, Olney P. O., Philadelphia, the inventor and maker of

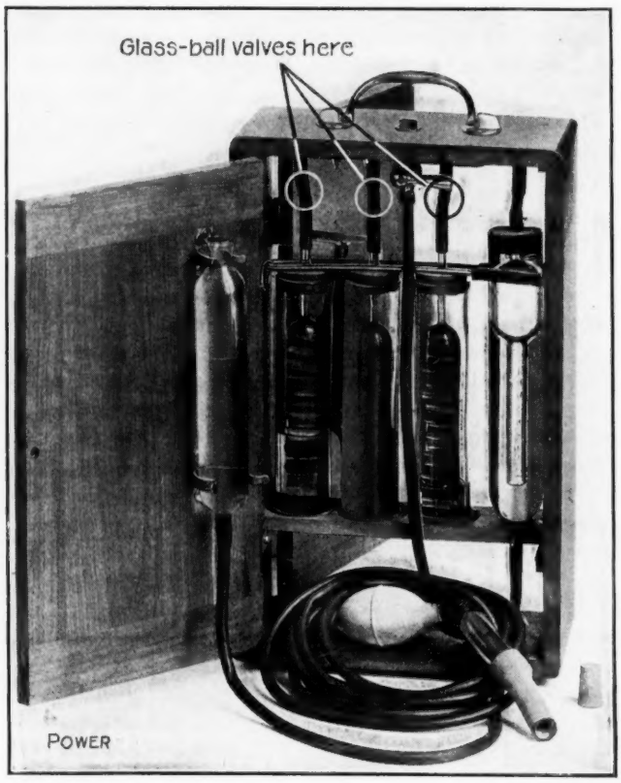


FIG. 1. THE FRANKLIN ANALYZER

the Franklin analyzer, uses a unique kind of valve for the tube connections to the pipettes.

As pinch cocks tend to "chew" holes in the rubber tubes and glass cocks frequently stick fast, Mr. Duemler uses an oblong glass ball or pellet inside the rubber tubing

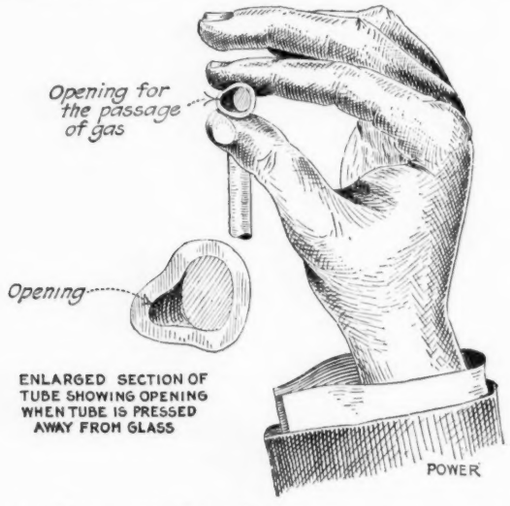

Opening for the passage of gas
Opening
ENLARGED SECTION OF TUBE SHOWING OPENING WHEN TUBE IS PRESSED AWAY FROM GLASS
POWER

FIG. 2. HOW THE TUBE IS PRESSED AWAY FROM THE GLASS PELLET TO ALLOW THE GAS TO PASS

from each pipette, the pellet being a tight fit in the tube. When it is desired to run the gas into a pipette, simply squeeze the tube surrounding the pellet with the thumb and forefinger as shown. This stretches the rubber away from the pellet, affording the gas a passage. This is shown in the enlarged sketch, Fig. 2.

Other commendable features of the apparatus are its accessibility and the ease with which the pipette may be dismounted and reloaded. The hinged spring wire, shown in Fig. 1, rests hard on top of the pipettes and is latched in notches on the side of the frame.

The apparatus may be used for O_2, CO and CO_2 determinations. Its price is $25.

Care of Low-Tension Ignition System

BY A. L. BRENNAN, JR.

Low-tension ignition, commonly referred to as mechanical make-and-break ignition, formerly was used almost exclusively, but has now given way, especially in small high-speed engines, to the high-tension, jump-spark system. This has been due chiefly to the greater flexibility of the latter. However, low-tension ignition offers a few advantages over high-tension sparking devices, principally because it is not so easily affected by moisture; therefore, motors thus fitted are better suited to operate under exposed conditions.

Since the movable electrode projects through the side of the cylinder, a certain amount of wear will result in a loss of compression; also, the actuating mechanism is subject to wear, which may interfere slightly with correct timing.

The spark produced by a mechanical igniter takes place while the points are being separated and not while they are apart, therefore it is important to have the actuating and controlling parts in good condition. The tension of the springs should be kept up to insure the points making a rapid break, and springs which have become weakened through wear or high temperatures can be improved by drawing them out a little, although it is better to substitute new springs wherever possible.

The contact points of the movable and stationary electrodes should be kept bright and free from carbon or other foreign deposits. Points that have become pitted will require filing, but in doing this care should be taken to work the contacts down to such an angle that their entire surfaces will touch. Unless this is done, no matter how clean the points may be, it will not be possible to obtain the best spark. If there is a decided tendency toward pitting, the current should be reversed about once a week.

Low-tension systems are subject to many of the troubles of other types, short and open circuits playing important rôles in this respect. The chief difference between an open and a short-circuit is that in the former the circuit is not complete, such as when the switch is open, while in the latter the switch is closed, but the current passes through a path of less resistance and fails to complete the circuit. Therefore, when confronted with ignition trouble, it is well to look to the switch first, as it is quite possible that it has been left open. If the switch is all right, the trouble can be traced to one or more of the following:

1. Loose or broken wires;
2. Broken-down insulation on wires;
3. Loose battery connections;
4. Dirty igniters;

5. Igniters "hung up" or otherwise inoperative;
6. Weak batteries.

If a storage battery is used, test with a low-candlepower lamp. Dry cells may be tested with an ammeter and should show at least 10 amp. If, on testing the set, there is no flow of current indicated, it is well to test each cell separately, for it often happens that a cell will be dead or affected by an "interior short," and thus affect the set.

To test a low-tension system, close the switch (if it is of the "exposed-blade" variety), and then pull it out quickly. If a spark appears at the contacts, the circuit is all right, and the trouble may be looked for in the igniter. On the other hand, if no spark appears at the switch, it would not necessarily show that the circuit is at fault, for unless the igniter points are together the circuit is open. Therefore, close the switch again, and with any handy tool complete the circuit from the stationary electrode to the motor and note if a good spark occurs.

Kv.-A. and Kw. Ratings and Effects of Low Power Factors

By A. L. Temple

Today, most alternating-current apparatus is rated and bought on a "kv.-a." basis of rating. Operators who have been used to dealing with direct-current apparatus or have a "kw." basis for loading their generators and transformers often fail to consider the importance and value of the kv.-a. rating in heating and other overload troubles at times of peak loads. Again, it is often thought that the kv.-a. rating is one thing and the kw. rating another, which is not strictly true, for every kv.-a. rating has several corresponding kw. ratings. This relation can be understood when it is remembered that the kv.-a. rating of a piece of alternating-current apparatus is independent of the power factor and equals volts times amperes, as shown by the switchboard meters. The kw. rating, on the other hand, does depend upon the power factor—that is, it varies with the power factor for the load that the machine can carry continuously without damage from heating. For such a load the kw. capacity is reduced as the power factor decreases and increases as the power factor is raised until, when the power factor is 100 per cent., the kw. and kv.-a. ratings are equal.

The kv.-a. rating is a help in indicating the safe load that a machine can carry because such a load depends upon the heating effect or the amperage flowing through the windings. If the power factor is low and the operator believes the machine to be capable of carrying 220 kw., with a generated voltage of 2200, then when the ammeter shows 100, he is led to believe that while the recording wattmeter shows that 220 kw. is not exceeded, he can run up the load, say to 125 amp. If the nameplate reads 220 kv.-a. instead of 220 kw then in this case the machine was fully loaded at 100 amp., and the reason the wattmeter did not show this was due to the power factor being low. If it took an indication of 125 amp. to show 220-kw. load, then the power factor was 80 per cent., a value often found on circuits carrying induction motors. If, as in this case, the machine had a kv.-a. rating of 220, its kw. rating at 80 per cent. power factor was 176 kw. and at 90 per cent., 198 kw.; that is, the machine would heat the same when carrying 176 kw. at 80 per cent. power factor as when carrying 198 kw. at 90 per cent. power factor. Thus by dividing the kv.-a. rating by the circuit voltage the safe current that can be carried by the winding is found, and the kw. load that can be carried to not exceed this current when induction motors are operated can be found as follows:

$$kw. \div power\ factor = kv.\text{-}a. = amperes \times volts$$

Allowable amperes = kw. ÷ (volts × power factor)

where the kw. is taken from the recording wattmeter, and the power factor is obtained by dividing the kw. wattmeter reading by the kv.-a. nameplate rating.

From this it is seen that if apparatus is ordered by a kw. rating it is necessary to state the power factor under which it will operate, so as to secure a machine large enough to carry the load expected.

A low power factor is very objectionable. When making extensions or additions to a system, a larger size of wire, and a larger transformer must be used than required with a higher power factor and a voltage drop is produced that is out of proportion to the drop due to the working current of the actual load. This makes it hard to hold a steady voltage, for any great variation of operation and load on the devices causing the low power factor cause fluctuations that are hard to control at the station except through continual juggling of the exciter fields or by means of expensive automatic devices.

When a low power factor is found on any system, the first thing to do is to find out the cause, which can generally be located in induction motors too large for the load carried and running light most of the time, transformers much too large for the load, and in a large number of arc lamps used on a power circuit. When such causes are found it is wise to change the motors and transformers if possible and place the arcs, if burned while the motor load is operated, on a separate circuit. If this cannot be done easily, it will be found worth while to consider the installation of a synchronous motor at some point on the line preferably near the center of load or in a substation or at the end of the line, if only one line is operated. The synchronous motor has a neutralizing effect and brings the conditions back to normal. This is brought about in the following way:

With a low power factor there flows in the lines a wattless current, which lags behind the voltage. By overexciting the fields of the synchronous motor it delivers back to the line a current leading the voltage. When this adjustment is made so that the current leads the voltage as much as the wattless current lags, then the power factor would theoretically be 100 per cent. It is found in practice that the size of motor required to bring about this ideal condition is more costly than the benefit of the improved power factor after reaching about 90 per cent. Up to this point a relatively small capacity of synchronous motor has a decided corrective effect. The use of the synchronous motor is attractive because at the same time it can carry 70 per cent. rated load as a motor.

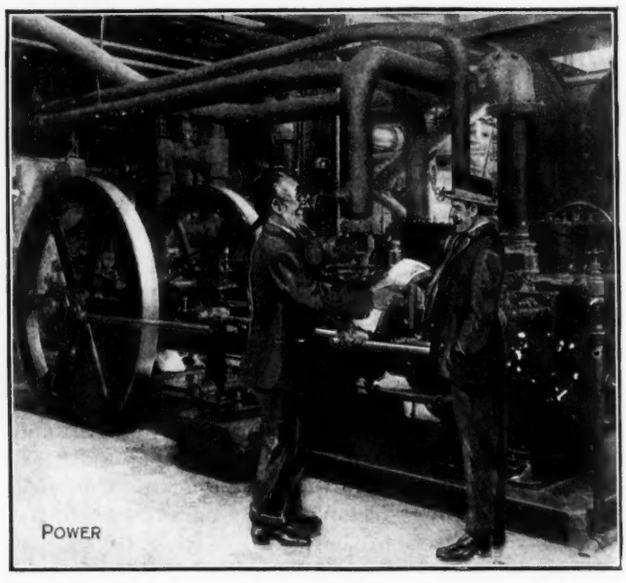
New York City Engineers' License Law

By Bill B. Banger

Well, fellers, it's so long since I've had a confab with th' bunch about this, that and t'other that I don't know whether I'll get into print or not. It's up to th' boss editor whether I can multiply a few pros and cons now and anon, but that's as may be.

Th' question before th' house is, "Has th' rights of th' American engineer been preserved?" and th' answer comes echoin' down the coal chute, "Damfino, but it's doubtful if they has."

Now, it all depends on where you live and whether you want a job as an engineer. If you are a workin' engineer



"I Told Williams I Wasn't Workin' with a New York City License, Didn't Have to and Hadn't Any Idea of Gettin' One, Police Department or No Department"

in New York City you'll probably believe th' rights of th' American engineer are all to th' good, seein's you'll probably take th' stand that all engineers livin' on th' outside are aliens with no more rights than a skunk in a sittin' room.

If you are livin' outside of New York City and happen to be so situated that a job at engineerin' has just got to be had to keep th' kids from goin' to th' poorhouse, you'll think you are worse nor a half-breed idiot, so far as rights go.

Th' engineers' license law of New York City is to my belief unconstitutional, and there's a lot of engineers in th' city gifted with a fair amount of human intelligence who think th' same. Gettin' down to anchor bolts, th' law must have been framed by a set of muts who, havin' a job, were mightily afraid they couldn't hold on if other engineers—who knew just as much, and probably more—were given half a chance to get into th' game and show some of 'em that all th' efficient engineers were not workin' in New York City.

This fact was brought vividly to my mind, as Tennyson—maybe 'twas Captain Marryat—says, by a long-time friend of mine who can set up an engin' with his eyes shut, and knows more in a minute than some engineers I've met in the city knows in a month. The firm he was workin' for was foolish enough to lose most of their money, and so it was a case of get a job operatin' until times were better. Seein's New York's his jumpin'-off place, and has some companies what knows a good engineer when he shows up—and want a good man anyway, whether he shows up or not—Williams, we'll call him, because it ain't his name, got a job as soon as he got onto Broadway.

Then he meandered down to police headquarters to make application for a license to run th' plant. As proof he wasn't playin' a flim-flam game, what is worked so easy in the Metropolis, Williams takes a Philadelphia city license and an Ohio State plaster, both of the first-class ratin', along as evidence to his standin' as an engineer.

But there was nothin' doin'. It didn't make a durned mite of difference how many gold-sealed plasters were put on exhibition, Williams found that he had to get th' signatures of three city engineers what had a license and were workin' at their trade and could certify that th' statements contained in th' application were true.

Some chance fur gettin' a license, by heck, fur a feller what don't know three engineers in th' whole burg. But it's evident to even a soused bum that a feller couldn't get two first-class licenses if he hadn't put in a few licks at throttle-twistin'.

This condition of engineerin' affairs is what a lot of engineers' in th' city favor, so as to keep outsiders from playin' in their ash heap.

When Williams blew into my engin' room and wanted me to sign his application for a license, I told him I'd do it so quick he'd think th' last world's series was bein' played if it would do any good, but th' fact was, I wasn't workin' under no New York City license, didn't have to, and hadn't any idea of gettin' one, police department or no department.

That kind of knocked Williams into a heap, so I went on to explain that th' license law was so loosely constructed that it was only necessary to have one licensed engineer on watch, no matter how many engineers were workin.'

"But you are th' chief engineer of this plant, ain't yer?" says he.

"You can put down your last dollar that I am," says I, "and there's no law to stop me from hangin' up my hat in this engine room and bein' th' cock of the roost, and if you have a licensed engineer in th' plant you want to run, all you've got to do is to get the company to tack on th' title of buildin' manager, assistant superintendent or somethin' else as meaningless, so as to get past a law what aims to keep you out of a job.

"Strictly speakin,' accordin' to law I ain't th' chief engineer here, but, on th' other hand, what I say goes first shot off th' bat, and it don't make any difference to me whether I'm called a chief or somethin' else."

In lookin' over Williams' application I noticed one

question put on with a rubber stamp, "Have you ever been convicted of a felony?" Williams said he hadn't, but it struck me as bein' mighty nigh onto a joke for the police inspection department to ask such a question. Some fellers don't seem to have a mite of humor.

As have other menial engineers, I have wondered now and anon, so to speak, just why th' inspection of boilers and th' issuin' of engineer certificates in New York City should be performed by th' police department. It don't stand to reason that a cop is capable of protectin' th' public against boiler explosions.

Under th' date of March 22, 1913, Charles G. Armstrong & Son submitted a report on th' system of boiler inspection and licensing of engineers and firemen under th' police department of New York City for th' aldermanic committee, in which was cited examples of th' trainin' of some of th' boiler squad previous to their service as "engineers." One feller actin' as a boiler inspector was previously a letter carrier, clerk and gasfitter, another had been a fireman and an oiler, and a third had held down the job of patrolman. One examiner, th' feller what looks you in th' face and passes judgment on your fitness to operate a steam plant, had been a clerk, lumber inspector and timekeeper. Now, how in tophet does these qualifications fit these men to do their full duty in an intelligent manner with justice to all and malice toward none?

Sometimes I think—but what's th' use? Th' law is on th' books and will be enforced if you don't get th' title of manager or somethin' else to sidestep this piece of unjust legislation what no engineer can be proud of and what takes away an American's rights to earn an honest dollar at his trade.

Them's my sentiments and if you don't like 'em it ain't my fault. Somethin's wrong somewhere, by heck!

Large Wheeler Cooling Towers

The accompanying illustration shows what is believed to be the largest cooling tower project ever undertaken. This battery of forced-draft towers was built for the Texas Power Co., Waco, Texas. They are of the steel shell type, arranged in a battery 100 ft. long, 18 ft. wide and 40 ft. high.

There are six pairs of 10-ft. fans operating at 250 r.p.m., and are belt driven by motors above each pair of fans in small motor houses. The fan housings are extended and are provided with doors which may be opened to permit of the unobstructed entrance of air by natural draft during the winter season. A platform, reached by a ladder from the ground, serves the three motor houses; an upper gallery is built on the level of the water distributors and the water-regulating valves which control the water discharge to each compartment.

Any section may be cut off for inspection or cleaning without interfering with the operation of any of the others. The water piping is designed for an additional installation of towers of equal capacity to the left of the present battery. The present equipment is designed to cool 600,000 gal. of water per hour. These cooling towers were built by the Wheeler Condenser & Engineering Co., Carteret, N. J.

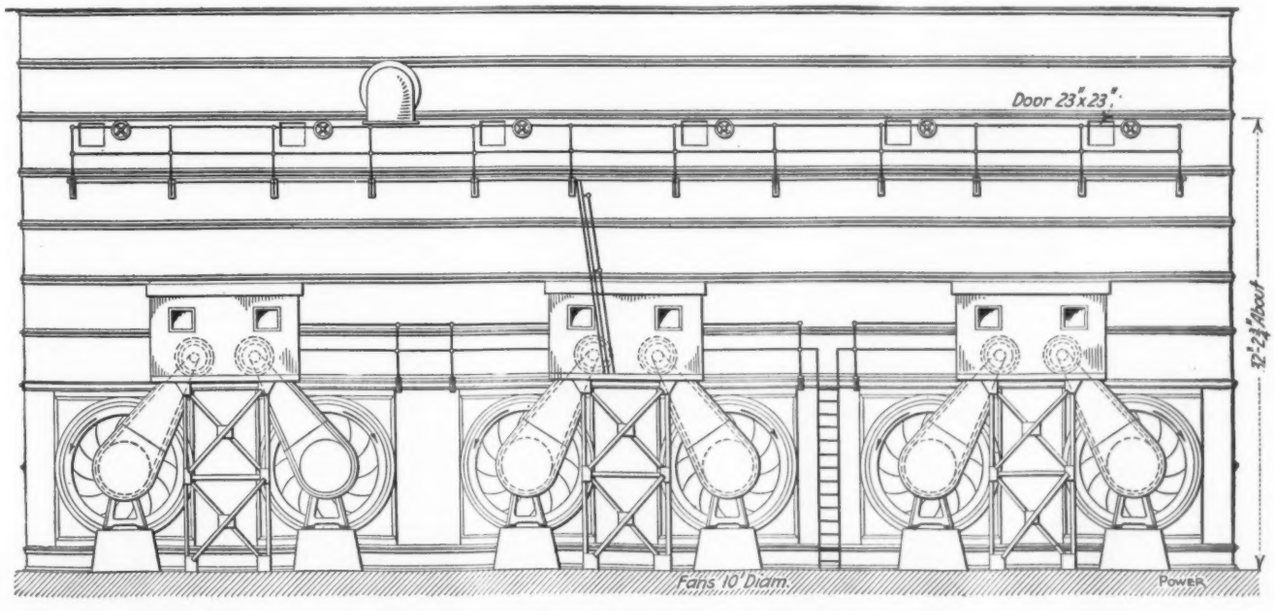
Calculating Pump Slippage

By J. C. Hawkins

One way to determine the approximate slippage* is to place a gage on the discharge side of the pump between the discharge chamber and the main discharge valve; also have a 1-in. pipe tapped into the discharge line at this point, with a valve and a short length of pipe attached. Then place barrels on scales or have a tank of known capacity to weigh or measure the test water. Close the main discharge valve tight or blank off the pipe if necessary and start the pump, letting it run only fast enough to keep the pressure up to that at which it is working when in service. Then open the test valve to the weighing barrels or tank, regulating the speed of the pump to maintain the same pressure in the discharge chamber.

When the test valve is opened count the number of

*Pump slippage is the difference between the water which should go out (displacement) and that which does (delivery), and is due to leaky pistons, plungers or valves.



General Arrangement of Cooling Tower

strokes of the piston until the tank is full. Calculate the displacement of the piston per stroke, multiply by the number of strokes and reduce the product to pounds or gallons, as desired. This will give the quantity of water that should have been pumped. Then weigh or measure the water actually pumped and divide by the displacement of the pump, which gives the percentage of water actually delivered at the average working pressure. This percentage subtracted from 100 gives the percentage of slippage that should be deducted as calculated from the displacement.

The slippage found in this manner may not be correct for the reason that part of the valve slippage takes place while the valve is closing and would be greater at high than at low speed, because the valve opens wider and the piston reverses quicker, but it is correct for all usual purposes.

R F M Flow Meter

A new type of flow meter for steam, air, water and gas has recently been made by the Republic Flow Meter Co., of Chicago, formerly known as the Steam Appliance Co. The measurement is made electrically and the result in

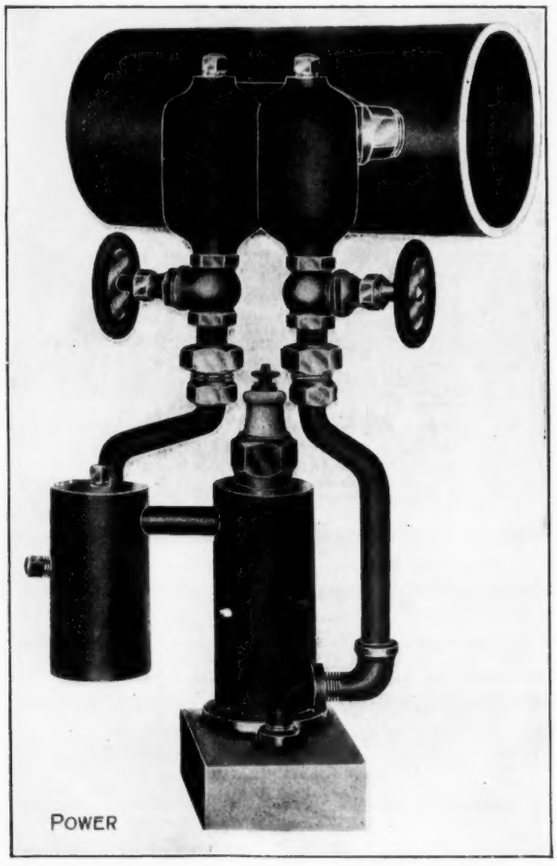


FIG. 1. R F M METER ATTACHED TO STEAM PIPE

units of flow may be read on the dials of electrical instruments which, in reality, are special ammeters.

The difference between the dynamic and static heads, or the velocity head in the pipe containing the medium to be measured, affects the height of a mercury column which in turn changes the resistance in the electrical circuit. As the velocity of the medium increases in the pipe to which the meter is attached, the mercury rises, cuts out resistance and consequently increases the current, so that the reading on the dial is greater.

An external view is shown in Fig. 1. It consists of two interconnected cylinders, two reservoirs, or condensers, and two meter tubes, the last named being shown to advantage in Fig. 2. The principle of operation, however, is more apparent in Fig. 3, as the cylinders are shown in section. The larger cylinder has a mercury

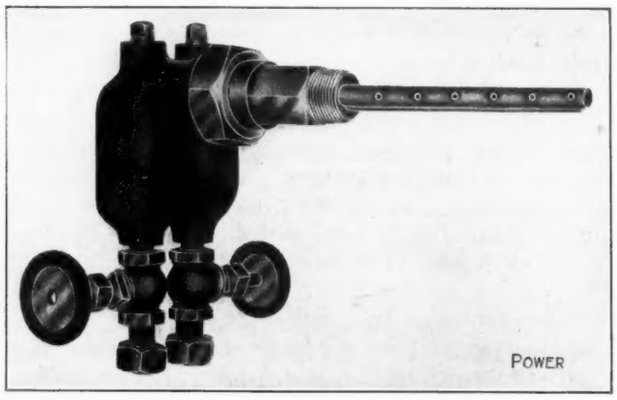


FIG. 2. METER TUBES AND RESERVOIRS

well at the bottom and at the top a resistance spool of "Advance" wire. From a fiber plug, on which the spool rests, steel wires, arranged in the form of a cylinder and of graduated lengths, project downward. These vertical wires are attached to the wire on the spool at different points of its length, so that a circuit may be formed through the entire resistance or through portions of it. The terminal plug is screwed into the top of the cylinder. The larger cylinder is sealed by the mercury well, and above that is filled with oil, as is the upper part of the smaller cylinder. The bottom part of the latter contains water.

When the medium is steam, the meter tubes, Fig. 2, enter the steam pipe through a single plug and can be turned in any position and the tube used for either vertical or horizontal pipes. The tube in the foreground connects with the dynamic reservoir and the openings shown must always face toward the direction of flow. The other tube connects with the static reservoir and the holes face to the rear or away from the flow of steam. The reservoirs are merely condensers which fill the connecting pipes with water. The dynamic head, due to pressure and velocity, bears down on the mercury well and tends to force its contents up into the cylinder. The static head—the pressure—is transmitted from the smaller cylinder to the larger, and resists the upper movement of the mercury. The difference in pressure, or the velocity head, determines the height of the column of mercury, and this height fixes the resistance left in the electrical circuit.

A set of instruments is furnished consisting of an indicating meter *A*, Fig. 3, a recording meter *R* and an integrating meter *I*. All three may be mounted on one board or individually at the points desired. It is also possible to duplicate the instruments; that is, have one meter or a complete set in the boiler room and another in the office, all giving readings from the one flow meter. The indicating meter is a special make of ammeter designed for one ampere. The recording meter is the same thing with a recording arm attached and clockwork to revolve a twenty-

four-hour chart. The integrating meter is specially designed so that the counters will move about ten times as fast as in the usual type of wattmeter.

These meters operate on alternating current only, at a pressure of 38 volts. A small transformer reduces the voltage of the supply to this point. In case there is only direct current in the plant, a rotary converter is added to the equipment at small expense.

The flow meter is not as complicated as the description would indicate; it is compact and hangs in one piece from the plug. The use of different types of instruments with the one flow meter and their location at any point

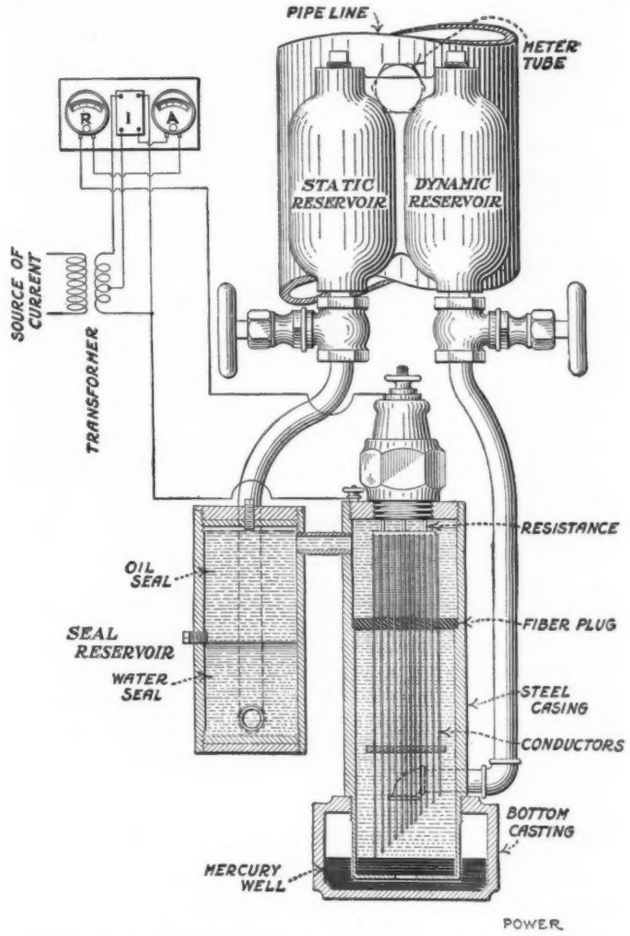


FIG. 3. SECTION THROUGH METER AND ELECTRICAL CONNECTIONS

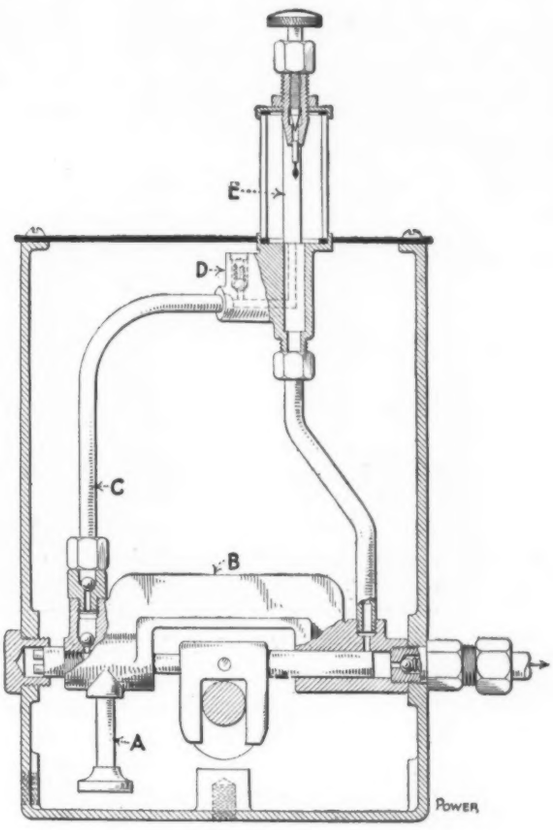
desired form an arrangement unusually convenient. As the meter is sealed there is no opportunity for the mercury to oxidize. Moderate prices and accurate measurement of the flow, due to the accuracy of the electrical instruments, are among the claims.

What Copper Casting Alloys Contain—Composition and approximate melting point of some of the more common casting alloys containing copper, zinc, tin and lead:

Alloys	Composition—Copper	Zinc	Tin	Lead	Melting Point, Deg. F.
Gun metal	88.0	2.0	10.0	....	1825
Leaded gun metal	85.4	1.9	9.7	3.0	1795
Red brass	85.0	5.0	5.0	....	1780
Low-grade red brass	81.5	10.4	3.1	5.0	1795
Leaded bronze	80.0	....	....	10.0	1735
Bronze with zinc	84.6	5.0	10.4	....	1795
Half yellow, half red	75.0	20.0	2.0	2.0	1690
Cast yellow brass	66.9	30.8	....	2.3	1645
Naval brass	61.7	36.9	1.4	....	1570

Krahn Force-Feed Lubricator

This oil pump is designed with a complete pump unit for each feed and can be removed without disturbing any other unit. The mechanism, fastened to the pump body, is immersed in oil, and, as the drive is positive, there is no slip between the driving medium and the ratchet, the driving lever of which moves through an angle of 76 degrees.



SECTIONAL VIEW OF THE KRAHN FORCE-FEED LUBRICATOR

An auxiliary hand lever is furnished with the ratchet pump and a disengaging head with the direct-drive pump so that oil can be forced to the engine bearings before starting.

The pump lever is operated from any suitable source on the engine and on the ratchet-driven pump a ratchet revolves the pump shaft in one direction, giving movement to the pump plunger through a crosshead. On the direct drive the pump shaft oscillates to give the plunger the required stroke.

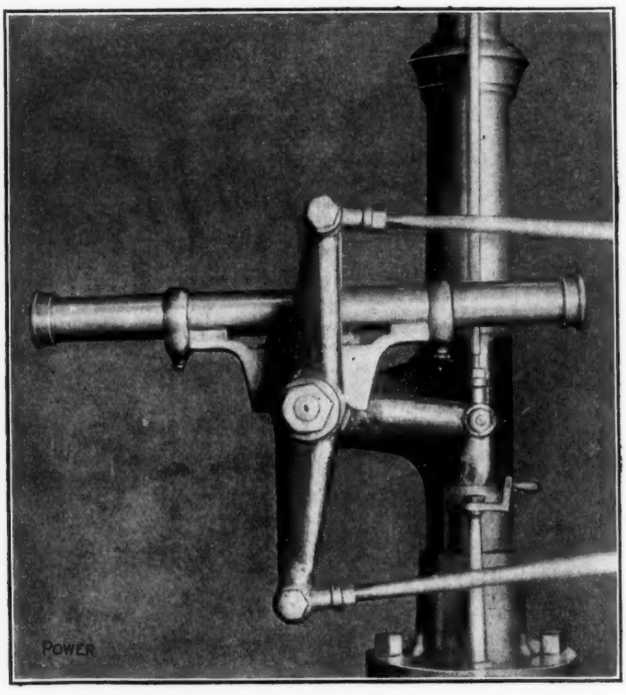
Oil is drawn by the plunger through the inlet pipe *A* into the cylinder *B*. On the return stroke the oil is forced into the pipe *C*, past the bypass *D* into the regulating valve *E*, where it drops from the drip nozzle through the sight feed and outlet pipe into the cylinder *B* and is forced out into the feed line past the check valve by the pump plunger on the next stroke.

This pump is made for 3-, 4-, 6- and 8-quart capacities with from one to eleven feeds. Compartment pumps are also built so that two grades of oil may be used.

This pump is made by the Krahn Manufacturing Co., Clinton and Lapham Sts., Milwaukee, Wis.

Corliss Governor Compensator

An ingenious device designed to assist the flyball governor of a Corliss engine in maintaining the speed within 1 per cent. from no load to 25 per cent. overload is shown in the accompanying illustration. It was patented in December, 1909, by C. P. Hall, chief engineer



Compensator on Corliss Governor

of the Rookery Building, Chicago, but has not received mention in the technical press.

The compensator consists of a tube 1½ in. in diameter, 19 in. long, capped at both ends and divided into several compartments which are partially filled with mercury. It is placed on top of the hub of the rocker-arm to which the reach rods are attached and secured by means of a saddle and stirrup. A space of 2½ in. is necessary between the governor rod and the inner face of the rocker-arm. The compensator is mounted level on the rocker-arm hub when the engine is running light at its usual speed and is bolted rigidly in place. Then when the governor tilts the rocker-arm in either direction, the compensator follows, and the mercury, concentrating its weight in the same direction, automatically aids the governor. In other words, the compensator has the same effect as automatically increasing or decreasing the weight of the balls when the engine speed is either side of normal. It thus adds to the power of the governor, and as the perforated division walls between compartments do not allow a sudden shift of the mercury, the compensator tends to steady the action of the governor and prevents racing.

For the past five years one of these compensators has been in operation on a 20x42-in. Corliss driving directly a 200-kw. direct-current generator at 100 r.p.m. The engine had seen 18 years of service before the device was applied. The load consists of lights and motors in an office building and varies from 100 to 250 kw., although not in a single shift. By actual count over a considerable period the speed did not vary one revolution. In rolling mills, sawmills and other places where the variation in load is extreme, the compensator should prove of value.

Dry-Jacket Soot Blower

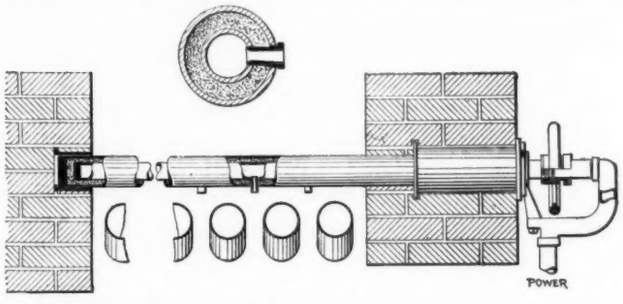
The dry-jacket soot blower is designed for use with a water-tube boiler and is intended to withstand high furnace temperatures without having to be replaced at short intervals.

The blower units which are exposed to a deteriorating temperature are made of two wrought-iron tubes, one within the other. The outside tube is 3½ in. in diameter, with a ½-in. space between the inner and outer tubes, which is filled with a specially prepared heat-resisting compound. These units are baked in ovens at an extremely high temperature until the compound becomes hardened and tile-like in formation.

This material is pressed tightly around the inner tube and forms an insulator so that the tube does not become red hot even in the hottest furnaces.

Another feature about this device is that each unit revolves on its own bearings and directs the steam between the tubes where soot may lodge. In cases where a complete revolution of the blower is not necessary, stops are provided to eliminate the waste of steam. The illustration shows a unit in its correct position with respect to the tubes.

Each unit is equipped with steel expansion nozzles which force the steam around and between the tubes at a high velocity, estimated to be 2500 ft. per second, al-



Blower in Correct Position with Respect to the Tubes

though no more steam is used than with an ordinary opening of the same size. Units not within reach from the floor are operated by sheave wheels and chains.

This blower is manufactured by the Diamond Power Specialty Co., Detroit, Mich.

Electrolysis Regulation in St. Paul—Following a brief report by Ray Palmer, commissioner of gas and electricity, Chicago, and recommendations on electrolysis on water mains in St. Paul, the water board will present bills to the street railway company for damages due to stray currents and ask the latter to coöperate with the board in the establishment of return feeders and continuity of service. In case the company refuses, Mr. Palmer recommended the passage of regulating ordinances similar to those in force in Ohio, St. Louis and Chicago.

Saved by a Bolt—In connection with the wreck of the gantry crane at the Marion station of the Public Service Corporation of New Jersey, we learn that a similar accident nearly occurred at the Bayonne works of the Babcock & Wilcox Co. Their large bridge crane ran to the end of the track and sheared off ten sets of track bolts, all that prevented it from going over being a last bolt which was half sheared off, but held.

Valve Area in Pumps

By A. B. Morrison, Jr.

SYNOPSIS—Discusses the relations of valve area to valve lift and pump speed.

In the selection of a reciprocating pump, whether direct-acting or power-driven, or in analyzing the operation of a pump which may not be giving satisfaction, the valve area is one of the most important things to investigate.

Valve area is usually expressed in percentage of the piston area, the actual net area through the valves being taken. The space occupied by the ribs and valve-stem support is subtracted from the area given by taking the circle whose diameter is the inside diameter of the valve seat. This net area is considerably less than would be given by taking the area of the rubber valve itself. For example, a 3-in. valve has a net area of less than 4 in., taking the valve as a whole, whereas the area of a 3-in. disk, such as the rubber valve, is from 40 to 50 per cent. of the area corresponding to the valve size.

Valve area in itself is not a sufficient criterion by which to judge a pump without knowing the size of the pump cylinder, the type of pump and the duty. The percentage of valve area in a given pump should be known in order to know the mean velocity of the liquid through the valves. This may be as high as 250 ft. per min. through the suction valves on large pumps, providing the pump is carefully designed for the service, and is usually the same through the discharge valves, which for shop reasons are generally made the same both in size and number as the suction valves. Broadly speaking, 200 ft. per minute is considered standard, the same as 100 ft. per min. piston speed is considered standard, both being approximate rules.

It is apparent that a small pump can have a smaller percentage of valve area to piston area than a large one and still operate satisfactorily. For mechanical reasons it is not practicable to run a short-stroke pump fast enough to approximate a piston speed of 100 ft. per min. A pump with 3-in. stroke, for instance, to run at 100 ft. piston speed, would have to make 400 strokes per min. Even though the pump could run at this excessive speed and not shake itself to pieces, the valves obviously could not open and close fast enough to keep up with the strokes of the pump. On the other hand, a 36-in. stroke pump running at only 33⅓ strokes per min. would give 100 ft. piston speed. Such a pump could operate at 40 strokes, or 120 ft., per min. without trouble and probably would be rated at this speed. Similarly, a 24-in. stroke pump at 50 strokes would give 100 ft. and would probably be rated at 25 revolutions.

Suppose that the 3-in. stroke pump is rated to give its capacity at 60 revolutions or 120 strokes. Then the piston speed is

$$\frac{120 \times 3}{12} = 30 \textit{ ft. per min.}$$

If the net valve area is 30 per cent. of the piston area then the velocity through the valves would be

$$\frac{30}{0.30} = 100 \textit{ ft. per min.}$$

If the 24-in. pump is operated at 25 revolutions or 100 ft. piston speed, with 30 per cent. valve area, then the velocity through the valves would be

$$\frac{100}{0.30} = 333 \textit{ ft.}$$

which is too high. Such a pump would have at least 50 per cent. valve area, giving 200 ft. velocity through the valves at the rated speed of 25 revolutions. It is apparent, therefore, that the factor to be considered is not the percentage of valve area alone, but the velocity through the valves as well, the latter being directly proportional to the former and dependent on the speed; the percentage of valve area usually depends on the size of the pump.

The size and shape of the water end have much to do with the satisfactory operation of the pump. If the water passages are large and direct, the pump will be more satisfactory at high speeds than if the water passages are narrow and long.

The size of the valve, regardless of its area, is also important. Suppose in a given pump the valves are nominally 6 in. diameter. The net area through the valves determines the velocity through the seat, but in order to secure egress, the liquid, after passing through the seat, must raise the valve and escape around the circumference. The valve area is a function of the square of the valve diameter, whereas the circumference of the valve is directly proportional to the diameter. The 6-in. valve would have an approximate net area of 14 sq.in., this being taken as 50 per cent. of the area of a 6-in. circle, 28.27 sq.in. Assume that the diameter of the inside of the valve seat over which the water must pass is approximately 5.5 in., the circumference of which is 17.3 in. That the liquid may pass out over the circumference of the

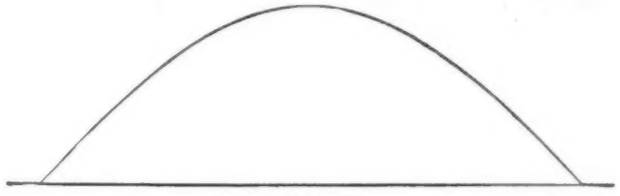


FIG. 1.

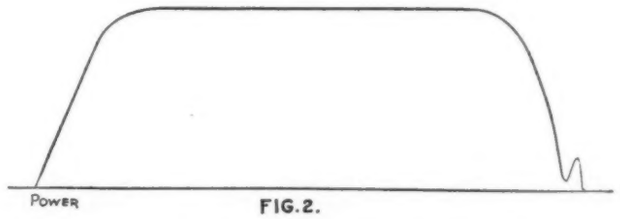


FIG. 2.

Discharge Velocity Curves from Power-Driven and Direct-Acting Reciprocating Pumps

valve at the same velocity as it passes through the seat, the valve must be lifted

$$\frac{14}{17.3} = 0.809 \text{ in.}$$

If the pump were short stroke and running at high speed there might not be time enough for the valve to raise and seat quietly and hammering might result. Suppose that 4-in. valves were substituted for 6-in. Assuming the area through the 4-in. valve to be 6.3 sq.in., or one-half of the area of a 4-in. circle, and the inside diameter of the valve seat to be 3⅝ in., which gives a circumference of 11.38 in., the lift of each valve would be

$$\frac{6.3}{11.38} = 0.554 \text{ in.}$$

or slightly more than half an inch. This condition would be more likely to insure quiet running, assuming the valve area to be the same in both cases.

If a pump is operating under heavy discharge pressure the speed must be low and the valve area large, with a slow water velocity to make sure of filling the cylinder and giving the valves time to seat before the pump starts its return stroke. On a high suction lift large valve area is a necessity, and here, too, slow speed is required. Before the valves can open, a considerable vacuum must be created and time allowed for the water to fill the cylinder before the return stroke is made. A pump on a high suction lift is likely to be troubled with air leaking through the joints of the suction pipe or entrained in the suction and released when the vacuum necessary to pull the water is produced. If the strokes are rapid, this air may not be expelled, but will be alternately compressed and expanded, causing the pump to knock and race. The same effect would be had if the valve area were so small that the pump could not fill properly, though in this latter case the trouble would be due to a partial vacuum and not to the air. With hot liquids, owing to their tendency to vaporize, slow speed is also essential.

The question as to relative valve areas between a direct-acting steam pump and a power-driven pump is hard to answer. Fig. 1 shows the velocity curve of the piston of a power-driven pump and Fig. 2 the curve for a direct-acting duplex pump, the hump at the end being caused by the cushioning. If the valve opening and closing followed in point of time the curve of the piston velocity, then the power pump would have the advantage, for the opening and closing would be gradual. This assumption does not appear to be borne out in practice. More power is required to open the valves than to hold them open, and a considerable vacuum is sometimes necessary in the cylinder before the valve raises. The opening and closing of the valve do not follow the velocity curve but are behind it. With the duplex direct-acting pump the motion is more rapid, as will be noted from the curve, and probably the valves open more quickly than in a power-driven pump and remain open for a longer time. The cushioning at the end allows the valves to seat before the return stroke is commenced. It would appear that for a given length of stroke the direct-acting pump would operate better on a lower percentage of valve area than the power pump, this conclusion being reached for the reason that probably the valves are open full for a greater part of the stroke. However, a power pump is nearly always a constant-speed machine, whereas the steam pump can be run at almost any speed within its limits, and is likely to be speeded at times beyond its rated and regular capacity. It is safe to figure on the same percentage of valve area for either type for the same sizes.

In pumping heavy and viscous liquids, as oils, tars, etc., the valve area should be larger than for water, since these liquids flow more slowly and the cylinder will not fill as readily. If the liquid has a specific gravity somewhat greater than water it should be remembered that for a given suction lift the vacuum produced by the pump must be greater than for water. A column of the liquid would exert a greater pressure than a similar column of water, due to its greater specific gravity, hence the vacuum in the cylinder must be greater for the pressure of the atmosphere to raise the liquid a given height.

The following table gives the average speed at which pumps of a given stroke are usually run (a revolution being taken as two strokes of a direct-acting pump) together with the percentage of net valve area advisable for both suction and discharge considered separately. These speeds may vary considerably up and down due to local conditions, particularly on the smaller sizes, a high suction lift, heavy viscous and hot liquids and high discharge pressures decreasing the speed; suction under pressure and low discharge pressure increase it.

Length of Stroke in Inches	Average maximum Revolutions per Minute	Minimum per Cent. Valve Area Advisable
2	80	20
3	70	20
4	60	25
6	60	35
8	55	40
10	55	50
12	50	50
16	40	50
18	30	50
20	30	50
24	25	50
36	20	60

On the shorter-stroke pumps the valve area is usually larger and the water passages are likely to be restricted.

Flow of Steam Through Pipes—There is perhaps no phase of power-plant design in which the rule-of-thumb methods are still adhered to so commonly as in the determination of the proper size of steam pipes.

This is due, apparently, to several reasons; the commonly accepted formulas are complex, are not any too well substantiated by experimental data nor based on sound theory; the tables given by various writers are incomplete and inconvenient. The engineer who installs pipes which are too large will seldom be criticized, for the mistake shows but slightly in the first cost of the entire plant and the large radiation losses remain unnoticed. Many designers overestimate the importance of keeping the pressure drop in the lines low. Loss of pressure in a pipe line carrying any fluid is due to friction, and results in the transformation of energy of motion of the fluid as a whole into molecular energy or heat. In a water line this heat is usually a total loss, but with steam flowing in well covered pipes most of this heat is carried on with the steam, raising its temperature or its quality. Thus, instead of being able to figure the percentage loss of power as being equal to the percentage of pressure, as is usually true for water or electricity, the loss is materially reduced by the return of the heat to the steam. Or, the total energy of each pound of steam just after entering the pipe is, heat energy + pressure × volume energy + energy of velocity along the pipe.

Before leaving the pipe the heat energy has been drawn upon to increase the volume and also to increase the velocity of the steam, while at the same time the friction has been absorbing a part of the energy of velocity and returning it in the form of heat energy. So, if the pipe could be perfectly insulated all the energy entering the pipe would be delivered at the other end.

Editorials

The Governors and Conservation

Once in every seven years the human body completely changes. We do not know how anyone knows that, but the wise ones claim it is so, and as we cannot prove that it is not, we have to accept it. But, granting that it is true, the human body has nothing on the body of governors of these sovereign states which for seven years has been assembling annually and, in that time, if it has not entirely changed its physical makeup, surely has completely changed its mind.

The very purpose of the original conclave was to arouse the people of this country to the dwindling supply of our natural resources and set in motion the machinery of government to the end that all possible wastes might be eliminated. "Conservation of our natural resources" was the keynote of the convention and became the popular slogan almost immediately. Such is our naturally buoyant nature as a people, however, that we just cannot keep ourselves indefinitely concerned about the welfare of future generations, and so after seven years the "Conservation Congress," as it had come to be known, proves to be almost the opposite. Sentiments were there expressed, as mentioned in the report of the meeting on page 761, that would have been set down as rank heresy had they been aired at the earlier conferences.

The only conservation that seemed to appeal at this particular gathering was that of state rights. The Western governors, especially, obviously preferred state to federal control. As to which is the better, so far as natural resources are concerned, is a question which we are not prepared to discuss further than to suggest that whichever one will make for the greatest solidarity of these United States as a nation would have our preference.

The history of Europe, particularly that at present in the making, proves the need of larger countries since now several have to unite for mutual protection against a common enemy. That which tends to separate our states by provoking jealousy and discord would tend toward the unhappy condition of affairs that is common to the Balkan States. Also, we should prefer that form of control which would be least approachable, supposing there were any unscrupulous combinations seeking to influence the legislators to favor them in the distribution of rights to the natural resources. In other words, we should favor that form of control which best conserved the benefits accruing from the natural resources to the people as a whole.

The ordinary consumers of electricity in St. Louis are still paying the same price for current that they paid before the Keokuk plant was built. The saving they should have enjoyed has become the profit of a few—a little gift from the Government, which probably will not repeat the error. Let us have no more Keokuks!

But, to return to the subject of conservation, we concur in the evident attitude of the governors as a whole that true conservation is not hoarding but wisely using, without wasting, the natural resources to the greatest good of the greatest number.

Hail, Calorigene!

Save your ashes. There is another scheme on to burn them. This time it is "Calorigene," and news of it comes out of the North. The *Ottawa Free Press* hails it as a "timely discovery," and says it will burn up seventy-five per cent. of the ash and effect a saving of twenty-five to fifty per cent. of the coal, in which case from one- to two-thirds of the coal would seem to need to be ash, unless the ash has more heat value than the coal itself.

The timeliness of the discovery, or of the announcement, to our mind, lies in the fact that the public has just about had time to forget Doctor Hoy and the Cobbler of Scranton. It was about seven years ago that they set the engineering world by the heels with their announcement that a solution of salt and oxalic acid would make a fuel bed out of an ash heap. Thousands of engineers all over the country set out to burn up their ashes. The Board of Education of New York City laid in a stock of the chemical and made the janitors use it. Quite a bit of unburned carbon which had found its way into ash barrels was saved by the second burning, but in the last analysis it was found that such of the so called ash as was burnable was carbon and would burn without the aid of the cobbler's compound, and such as was really ash was beyond resuscitation. The cobbler presumably went back to his last and the doctor who financed the scheme shot himself.

Low-Priced Goods

"Quality first" is an excellent slogan, but what is quality?

The best quality of babbitt metal for a main bearing may be the most highly priced brand. If it is to be used to fill a blowhole in a casting, type metal may be the best as well as the cheapest. The most expensive cylinder oil may be none too good in the cylinder, but for the line shaft, where it is expected to run cool, it may be the most expensive. Georgia Creek coal may be the best as well as most expensive, but if there is a pile of sawdust handy that you cannot float down stream it may be cheaper to burn that instead.

The greatest difficulty, however, comes in the fact that many things, from globe valves to engines, masquerade as of high quality when they are not. Finish may be substituted for quality, both of material and workmanship.

That there is a legitimate field for cheap goods in all these lines cannot be denied. In construction work, where temporary plants are used, and where the salvage on removal is far from complete, no matter what material is used; where the work is in the nature of experiment, or where the conditions are such that acidity in the water must be tolerated for a time—in these and in many other

instances a cheap grade of material is the most economical. The difficulty is to prevent this material masquerading as good material at low cost.

Unfortunately, many have an obsession that all manufacturers make a profit of several hundred per cent. on their products. These misguided people honestly believe that it is possible to buy at half the price of the real article and still leave the manufacturer profit enough to continue to do business. If such men would only keep track of the percentage of failures of manufacturers, they might see that they are mistaken. As it is, they make an easily gullible section of the purchasing public that is exploited by the more or less irresponsible dealer in "just-as-good" goods.

The Periodical Overhaul

How long has it been since each or any machine under your charge has been overhauled? Some have the habit of letting everything go so long as it runs and do not think of repairs or renewals until there is an absolute breakdown. The most careful engineer cannot avoid all mishaps and, no matter how alert he may be to the first signs of weakness or improper conditions, he will occasionally have troubles of one kind or another. Nevertheless, it is a safe wager that the man who looks ahead to avoid such things will have less of them than he who waits to act under compulsion. Herein lies the value of the periodical overhaul.

This is not to say that once a year everything should be gone over, although this is a better rule than none at all, but, at certain intervals greater or less in length, depending on the nature of the apparatus, everything should have a thorough examination, internal as well as external. This goes beyond the simple tests as of safety valves or engine stops, which, of course, should be tried at least once every day. We refer rather to the actual taking apart of every piece of running equipment until all vulnerable parts are exposed. Scored cylinders, broken or ill-fitting rings, worn bearings, clogged oil holes and countless other little things may exist for some time before they make themselves evident in the routine operation. They may come about so gradually that change of sound in the running is not sufficient from day to day to disclose their presence. A crack in a concealed part may mean real danger if not discovered in time and the periodical overhaul may reveal it before it has done any mischief.

The overhaul naturally includes, first of all, a thorough cleaning, but some make that practically the full extent of the work. Others will go far enough to search out and adjust, fit or renew such members as show too much wear and probably also replace parts that show serious effects of corrosion. The ultracautious will separate all the pieces that are not riveted or otherwise joined in such a way that it would be inadvisable to disturb them, and measure or test them with a hammer, as the case may be, to see if they are worn or distorted or in any way unsound.

Even if an overhaul proves to have been unnecessary, it is instructive at any rate to those who take part in it, and is the best of training for the whole force. Notes taken and retained of the findings may prove of considerable later value.

Edison Rate Case Postponed

Just at a time when the public, after two or more years of patient waiting, had reason to expect an early decision in the Edison rate case, comes the announcement that the Public Service Commission has granted a rehearing, based on the contention of the company's attorneys that insufficient information has been called for and submitted. Whether this contention is well founded we are not prepared to say; that it should have taken the commission two years to find this out is inexcusable.

Commenting on this case three weeks ago, we sought to give the commission the benefit of the doubt, and ascribed the slow progress to a desire to be thorough and omit nothing which would be pertinent to the establishment of equitable rates. That we spoke too soon is apparent.

Where the New York commission has so miserably failed to accomplish results similar commissions have been highly successful in other states, notably Missouri (see page 761), where in six months two important decisions were rendered in which a complete readjustment of rates has been ordered. In each of these cases, all factors entering into the cost of production were thoroughly investigated. These, although less in scope, were not essentially different from those involved in the Edison case. When it is recalled that the salaries of the Missouri commissioners are five thousand five hundred dollars each per annum as against fifteen thousand dollars for the New York commissioners, one does not have to figure long to judge in which state the public has made the better investment.

If the advocates of municipal ownership are prone to be overenthusiastic and visionary, its opponents do not always display a highminded disposition to get at the truth, whichever side it hits. Cleveland, Ohio, has gone further in the direction of operating its own public utilities than any other American city, and has recently completed the largest municipally owned electric-light station in the country. Mr. Ballard, the engineer, estimated that such a station could be made self-supporting with a maximum charge of three cents per kilowatt-hour. The first three months' operation seemed to justify the estimate of operating expenses upon which this claim was based, but the station has been running, naturally during the period of inauguration, at a very low load factor, not more than one-quarter of the load for which it is designed being carried. This has, of course, made the cost per kilowatt-hour, including the fixed charges, high, whereupon the publicity agent of the Antis gets busy and floods the country with accounts of "another municipal-ownership fizzle," telling in apparent sincerity how the current at Cleveland is costing four to five times as much as the engineer estimated.

And the funny and exasperating part of it is that engineers who ought to know better swallow the story, bait, hook and sinker.

The engineer (?) who hangs a weight upon the lever of the safety valve has been outdone by the man who put the weight of a New York sidewalk on his, by wedging the valve against it. The wedge held, but the boiler head did not.

Correspondence

What Caused the Break?

As to the broken crankshaft described by E. E. Merrill, on page 613, Oct. 27, it is very evident that there was a sudden abnormal load on the generator.

Cylinder No. 2 was probably firing at this same instant and as ammonia compressors usually have heavy flywheels, their momentum, added to the force of the explosion in No. 2 cylinder, would oppose the sudden retarding force due to the short-circuit and tend to localize the strain at No. 2 crank at about the place the break actually occurred.

The shaft may have had an unsuspected flaw of long standing. Again, as the babbitt was nearly all gone from bearings Nos. 1 and 3, if the engine had been running in this condition there might have been continued weakening due to the loose bearings. It would be interesting to know whether there was any jump in the shaft when No. 1 fired and what apparatus there was to protect the generator from overload.

EARL PAGETT.

Coffeyville, Kan.

As the shaft ran on five bearings and the break occurred between Nos. 2 and 3, it being found that the babbitt was wiped out of bearings 1 and 3, it seems to me that the power impulses distorted the shaft until it crystallized and weakened. It is evident that the shaft was held rigidly between bearings 4 and 5, so that it bent at every impulse until it broke. This frequently happens on high-speed automobile motors.

FORREST R. CARPENTER.

Salmon Falls, N. H.

[A high bearing between two low ones will surely cause a shaft revolving in them to break in time. This method is sometimes used to test material.—EDITOR.]

First Boiler Explosion in Atlantic City

On the night of Sept. 29, a boiler explosion occurred in Atlantic City, N. J., which is said to be the first in its history.

While this is a good record, it is more from good luck than any other cause, for there are many boilers there which have never been inspected. Many are insured and receive regular inspections, but there is no assurance that the boilers are being kept in a safe condition.

The wrecked boiler was a 40-hp. vertical, 44 in. diameter by 12 ft. high, with shell plates ⅜ in. thick, having double-riveted lap-seam longitudinal joints. The furnace, 40 in. diameter by 40 in. high, made of $\frac{5}{16}$-in. sheets, was supported by only two rows of ¾-in. stay-bolts. The furnace sheets collapsed, Figs. 1 and 2, the cause being the corrosion of the stay-bolts, which had wasted to ¼ in. at the furnace sheet. The safety valve was set at 40 lb., and just previous to the explosion the gage showed 30 lb. Probably transporting the boiler broke some of the stay-bolts (it had been moved lately), owing to their greatly reduced area, and the furnace sheet had bulged gradually, thus straining those stay-bolts still holding.

FIGS. 1 AND 2. SIDE SHEET OF FURNACE

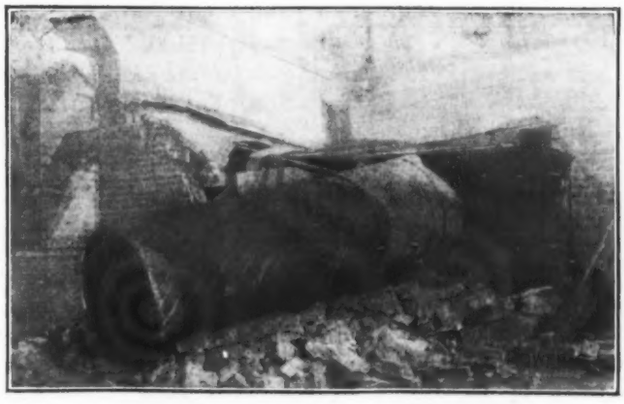


FIG. 3. BRICK WALL CRUSHED

The sudden release of the water and steam forced the boiler upward through the roof, and it landed on a wagon shed. That it went up a considerable distance is indicated by the broken wall where it rested after falling, Fig. 3, five or six feet of which was crushed as though made of cardboard.

One lesson from this accident is the necessity of hollow stay-bolts. A leaky stay-bolt can readily be renewed at a cost far less than a new boiler and possibly a suit for damages. In the case mentioned above one life was lost.

Atlantic City has an engineers' license law, but this plant had managed to elude the law and had no licensed man in charge.

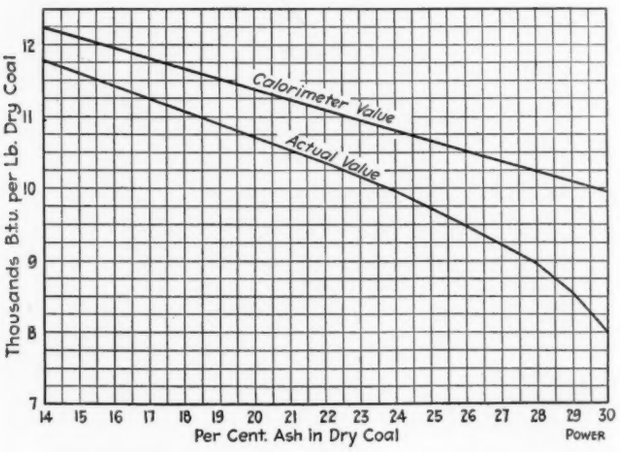
R. W. Robinson.

Germantown, Penn.

Ash Influence on Fuel Value of Small Anthracite Coal

There were two errors in my article under the above caption in the Sept. 22 issue.

The first occurred in Fig. 2, in which the marginal line read "B.t.u. per thousand pounds dry coal" instead



Reproduction of Mr. Philo's Fig. 2.

of "thousands B.t.u. per pound dry coal," as submitted with the chart.

I made the second error in the formula for loss of combustible in copying from my notes. The formula should read:

$$\text{Per cent. total combustible lost} = \frac{(\text{per cent. ash in dry coal}) \times (\text{per cent. combustible in dry refuse})}{(100 - \text{per cent. ash in dry coal}) \times (100 - \text{per cent. combustible in dry refuse})}$$

Frank G. Philo.

New York City.

Recovery of Gas-Engine Waste Heat

In the Oct. 6 issue appeared an article on the "Recovery of Gas-Engine Waste Heat." The writer some time ago secured a patent on the same system for generating steam, but at less than atmospheric pressure. In a small engine, with thin cylinder walls, using natural gas, it is possible to reach high temperatures without premature ignition, but in engines with thick walls and using gasoline, illuminating or producer gas, the temperatures have to be kept down, and in vacuum heating systems temperatures below 210° are desired. The outfit consists of a small centrifugal pump circulating water through the jackets and a closed tank higher than the engine in which steam is generated. Gravity makes the pressure in the jackets so high that no steam is generated there.

The Westinghouse Machine Co. ran some tests on such an outfit with the following results:

24.9 per cent. converted into work.

35.1 per cent. obtained from the jackets.

23.8 per cent. obtained from the exhaust in a form suitable for heating. The engine was 200 hp. and used 10.6 cu.ft. of natural gas per hour, having a heat value of 966 B.t.u. per cu.ft.

E. S. McClelland,
Engineer Gas Engine and Producer Dept.,
Westinghouse Machine Co.

East Pittsburgh, Penn.

Shutting Off Cooling Water Too Soon

Where bearings are water-jacketed and in cylinder jackets where it is necessary to use cooling water carrying a large amount of scale-forming matter, the water should not be shut off too soon after the machine has been stopped.

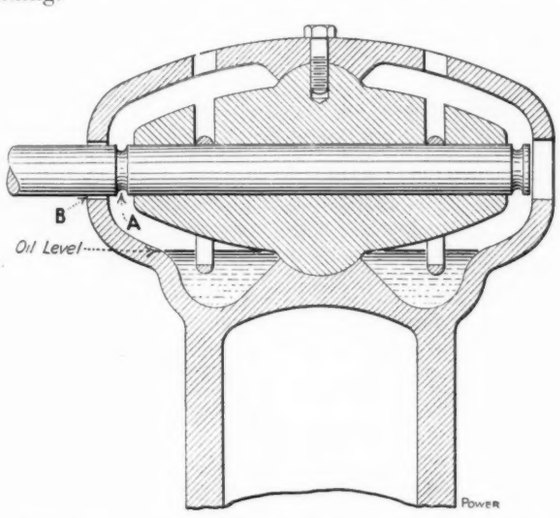
Water left in the coils or jacket will soon reach a temperature at which it will give up lime or scale-forming solids; during the period of operation the temperature of discharge water is usually below this point. It can be readily seen that a machine operating intermittently could have its cooling coils scaled up worse than one operating continuously. In some localities the well or spring water will begin to precipitate as low as 106 deg. F. Trapped jacket water may reach a temperature of 150 deg. F. in a few minutes after stopping the flow.

John F. Hurst.

Louisville, Ky.

Case of Oil Throwing

A second-hand 75-kw. motor was overhauled and set up to run as a generator. After starting, it was found that oil was flying from the shaft into the armature winding.



Section through Bearing Showing How Oil Leaked Out

The construction of the bearing was as shown in the sketch, and it was a puzzle to know how the oil got by the oil guard *A*. The cap was removed and an examination

made. Everything was apparently as it should be, but on starting again the same condition prevailed. The cap was again removed, the oil wiped from the shaft and the armature turned over by hand. A small trace of oil showed faintly on the shaft outside the groove *A*. It finally developed that the clearance between the shaft and the bearing shell was so small that the oil, running down from the top half of the shell, found its way along the edge *B*, and was picked up by the shaft and thrown out. The bearing pedestal was taken off and the shell cut down slightly and beveled inward to a feather edge. After assembling again and starting, the oil remained in the bearing.

EARL PAGETT.

Coffeyville, Kan.

Leaky Check Valve

A laundry boiler was fed from the city main as the pressure in the mains was usually 25 lb. above that in the boiler. One day the fireman noticed the water gradually disappearing from the glass gage, and the wider the valve was opened the more rapidly the water went down.

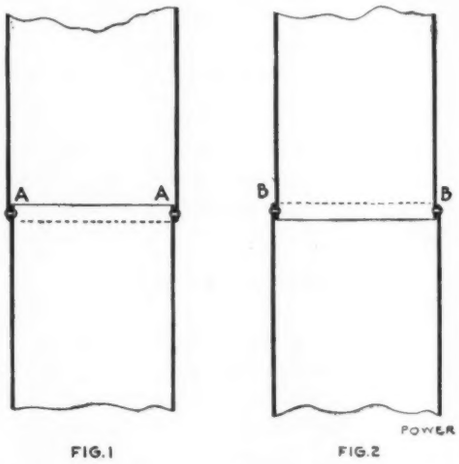
The plant was shut down and the fires pulled. The feed valve having been left open, the water came back in the glass at 60-lb. steam pressure. It was learned that the street pressure had been reduced and that the pressure in the boiler had forced the water out into the street main because the check valve leaked.

EDWARD T. BINNS.

Philadelphia, Penn.

Lap of Girth Seams of Steel Stacks

It is sometimes questioned whether the girth seams of a steel stack should be made with the upper sheet lapping over the lower like Fig. 1 or with the upper sheet inside of the lower as in Fig. 2. The disadvantage claimed for



METHODS OF LAPPING GIRTH SEAMS OF STEEL

the construction like Fig. 1 is that soot and ashes lodging on the edge *A* find their way through crevices in the joint and are washed down the outside by rain, causing the paint to be removed and the stack to rust from the outside. This is likely to occur with stacks made of material too thin to be calked. On the other hand, a stack made with joints like that shown in Fig. 2 is more likely to become rusted out at the girth joints by rain water entering at *B*.

Several years ago we had a stack made where each course entered the course below it like Fig. 2, and we got longer service out of this stack than the one which it replaced, which had joints made by lapping the upper over the lower courses like Fig. 1.

Later, we installed a new boiler with a new steel stack made as in Fig. 2 and got only about two years' service out of it, though it should be stated that we used steam jets for smoke consuming under this boiler. This may have had something to do with its short life.

I believe the main thing in a steel stack is to get good material and have the joints made tight and the stack painted often. The rust and soot gathered at the joints should be cleaned off frequently, otherwise painting will be of little purpose in prolonging the durability of the stack.

H. A. JAHNKE.

Milwaukee, Wis.

Tests of Substitutes for Gasoline

The article entitled, "Tests of Substitutes for Gasoline," in the Oct. 20 issue, is worthy of commendation, not only because it gives the results of carefully made tests in an almost virgin field, but also because the subject is of commercial importance. The wide sale of agricultural engines and tractors adapted to the use of kerosene instead of the more expensive gasoline is the best possible proof of the demand for such machines, and anything which throws light on the problems involved in the use of kerosene is worth while.

In a footnote on the first page, the following statement is made: "Natural gas contains some methane (CH_4), pentane (C_5H_{12}), hexane (C_6H_{14}), etc., all of which are liquid at ordinary temperatures after they have been removed from the gas." Part of this statement is erroneous.

It is true that natural gas contains methane, propane and hexane. Methane often forms 96 per cent. or more of the mixture commonly called natural gas; on the other hand, pentane and hexane occur only as traces in most natural gas and in slightly larger quantities in the varieties of gas drawn from oil wells. It is not true that methane is liquid at ordinary temperatures after being removed from the gas.

The critical temperature of methane is —95.5 deg. C. (—139.9 deg. F.). Recalling that the critical temperature is that above which a gas cannot be liquefied, it is obvious that methane could not possibly exist as a liquid at ordinary temperatures even under the highest pressures. Furthermore, methane boils under atmospheric pressure at a temperature of —164 deg. C. (—263.2 deg. F.), so that if it existed in liquid form under atmospheric pressure, it would boil away completely at more than 300 deg. F. below ordinary temperatures.

With pentane and hexane, the case is different. The critical temperature of pentane is +194.8 deg. C. (382.64 deg. F.); that of hexane is +250.3 deg. C. (482.54 deg. F.). Obviously, both of these materials could exist as liquids at ordinary temperatures because such temperatures are well below the respective critical values. The respective boiling temperatures at atmospheric pressure

are 36.2 deg. C. (97 deg. F.) and 69 deg. C. (156.2 deg. F.). From these values it is evident that pentane can exist as a liquid exposed to the atmosphere at moderate temperatures, but that it would boil away on a hot day; while hexane is a more stable liquid and highly volatile, it would not boil at any natural temperature. As a matter of fact, hexane is just about as volatile as the very highest grades of gasoline, while pentane is too volatile to be handled in liquid form excepting under the most unnatural conditions.

All of the members of the paraffin series, to which methane, pentane and hexane belong, are mutually soluble. Therefore, it is probable that small quantities of methane would be held in solution in any liquefied hexane procured from natural gas, in just the same way as many gases are held in solution in water and similar liquids. This might be regarded as liquefaction, but it is not the sort commonly meant by the expression "liquid at ordinary temperatures."

In the article under discussion, the manufacture of gasoline by the cracking process is briefly discussed. It might be well to note that gasoline made in this way is very different from that made by the process of fractional distillation. Most tests applied to gasoline are of a physical nature and generally consist of a determination of the gravity and the making of a fractional distillation. Both kinds of gasoline can be made to appear identical under these tests, but chemically they are very different.

Gasoline obtained by the fractional distillation of a paraffin-base oil consists almost entirely of members of the paraffin series. Gasoline obtained by cracking heavier paraffins consists of a mixture of paraffins, or saturated hydrocarbons, with unsaturated and with ring hydrocarbons. The chemical properties are therefore different, and since combustion phenomena depend on chemical properties, the characteristics in this respect are also different.

Little experimental work has been done along these lines in the case of gasoline, but kerosenes made by cracking have been carefully compared with those made by fractional distillation and different properties have been observed. Cracked kerosenes exhibit a greater tendency to burn with a smoky flame and to deposit carbon than do uncracked kerosenes. They also form more evil-smelling compounds during the combustion process and, in general, act like a less pure and less tractable material. It is probable that differences of the same kind, though possibly not of the same extent, also exist between gasolines made by the two processes. If this be true, cracked gasoline should behave somewhat like kerosene in an engine cylinder and many claim that cracked gasolines cause more rapid and more plentiful deposition of carbon in cylinders than do fractionally distilled gasolines.

The engine used in making the tests described in Professor Moyer's article was governed by the hit-and-miss method. By far the greater number of small engines in use are governed in this way, and the demonstration that kerosene can be successfully used in such engines is important. On the other hand, attention should be called to the fact that kerosene-burning engines should, when possible, be governed by throttling.

Hit-and-miss governing causes great fluctuations in cylinder-wall temperatures and in the proportions of the mixture, as has been demonstrated by means of thermocouples and indicator diagrams. It so happens that an engine using gasoline can operate satisfactorily despite such erratic variations; the case is very different with kerosene.

The performance of an engine on kerosene may be described as inelastic in comparison with its performance on gasoline. It can be made to operate, but it is far more sensitive to small misadjustments. A slightly cooled wall causes the deposition of liquid kerosene. A slightly cooled mixture prevents the completion of vaporization and leaves some of the kerosene suspended in the clearance space in the form of an incombustible fog. A slight overdose of kerosene immediately causes signs of trouble, while a gasoline engine can be operated for hours with 50 per cent. excess of gasoline without displaying any marked symptoms.

Since throttle governing tends toward gradual changes and therefore more steady conditions, it is possible to obtain better operating results with kerosene when this method is used. This is particularly true when the water injection is put under the control of the governor. With a throttle-governed engine, water injection is not ordinarily required at a load below 40 to 50 per cent. of rating, though very small quantities may be injected advantageously at the lower loads. As the load increases above 50 per cent., more and more water is required, until at maximum capacity a volume of water anywhere between 50 and 100 per cent. of the volume of the fuel is used.

Compare such operation with that of the engine used in the tests. The water was injected through a hand-controlled needle valve and must of necessity have been the same in quantity immediately after a missed cycle as after several hits. It is obvious that a cylinder already cooled by several misses does not require further cooling by water injection. As a matter of fact, it is possible, though not probable, that the engine under test was so operated that water was even admitted during missed cycles.

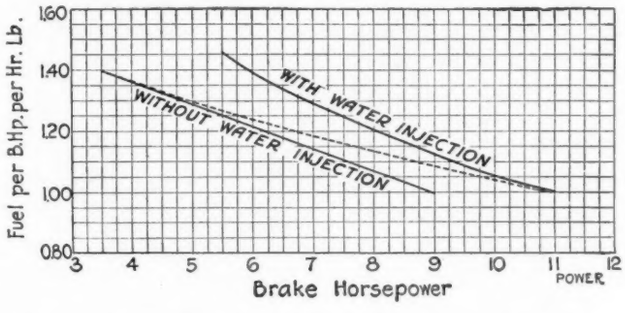


FIG. 1. ASSUMED FUEL-RATE CURVE FOR THROTTLE-GOVERNED ENGINE

In view of this, the curves and data given by Professor Moyer should be regarded only as applying to an engine of the type tested when operating under similar conditions, and the conclusions drawn should not be generalized and applied to all forms of kerosene-burning engines with water injection.

It is probable that a throttle-governed engine operating on kerosene will give about the same thermal efficiency at light loads as did the hit-and-miss governed engine in these tests when operating at corresponding loads. This is not theoretically correct, but practice is at variance with the simpler theory in this regard. It may be assumed further that at maximum load the throttle-governed engine with water injection is practically the equivalent

of the hit-and-miss governed engine with water injection. With these assumptions, the fuel-rate curve of a throttle-governed engine can be approximated from the data given by Professor Moyer. Such a curve is shown dotted in Fig. 1, the full lines representing the curves of Fig. 1 in the original article. It will be observed that this new curve is almost a straight line coinciding at light loads with that of a hit-and-miss engine without water injection and at heavy loads with that of a hit-and-miss engine with water injection.

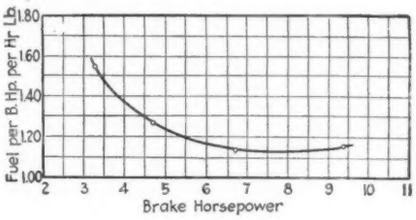


FIG. 2. CHARACTERISTIC FUEL-RATE CURVE

The characteristic fuel-rate curve of an internal-combustion engine is similar to that shown in Fig. 2, which is a reproduction of that in the original article. This characteristic curve is markedly convex and is very different in shape from that shown dotted in Fig. 1 as the probable curve of a throttle-governed engine with properly controlled water injection. The straightness of the proposed curve is explained by the fact that water injection raises the consumption per brake horsepower at the higher loads in the same way as occurred at all loads in the tests recorded. It should be noted at this point that one of the numerous functions of injected water is the cooling of the charge in a way and at a speed which it is impossible for jacket water to imitate. It should also be noted that the internal surfaces of the engine cylinder should be operated at the highest feasible temperature when using kerosene, in order to prevent the deposition of liquid kerosene on those surfaces. These observations point to the possibility and the desirability of operating engines of this type with higher jacket temperatures than is customary with gasoline engines, particularly at high loads when the quantity of water injected is great. Such operation would decrease the quantity of heat lost to the jacket and would probably decrease the fuel consumption per unit at high loads. This would, in turn, make the fuel-rate curve approach nearer to the characteristic shape previously mentioned.

It is hoped that these tests may be continued and extended to cover other sizes and types of engines. It is suggested that the use of heated air might also be compared with the use of a heated carburetor as used in these tests and that the injection of water into the suction pipe might be compared with injection of water directly through the wall of the cylinder. It would also be well to investigate the effect of the temperature of the water injected, as there is a wide range of temperatures available in any operating engine. The writer has always believed that the higher the temperature of the water, the better. In fact, it seems reasonable to believe that the injection of steam would give even better results than the injection of hot water.

C. F. HIRSHFELD.

Detroit, Mich.

Spacing Flange-Bolt Holes

Referring to the query from "W. F. L." in the Aug. 4 issue, regarding spacing of holes on a circle by the use of dividers, I wish to call attention to the spacing tables given on pages 67, 68 and 69 of *Machinery's Handbook*. For the example given of nine holes in an 18-in. bolt circle, on page 69, we find for a 9-in. circle and nine divisions a chord length of 3.078 in., or for the 18-in. circle the setting would be

$$3.078 \times 2 = 6.156 \text{ in.}$$

This value can readily be checked from the value of the sine of half the arc. With nine holes the arc between holes will be

$$\frac{360}{9} = 40 \text{ deg.}$$

The sine of $(\frac{40}{2} =)$ 20 deg. is 0.342. Hence the chord for an arc of 40 deg. on a circle of unit radius will be 0.684 and for one of 9-in. radius

$$0.684 \times 9 = 6.156.$$

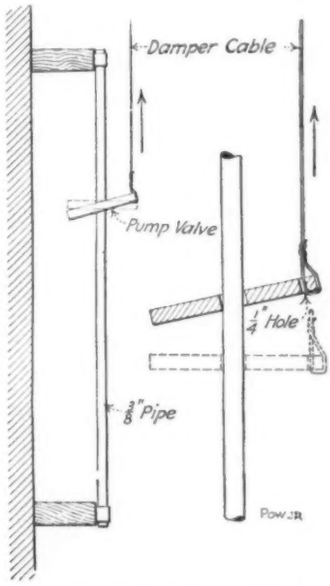
G. W. PARK.

West Allis, Wis.

[This is interesting as a mathematical method, but the one given on the "Inquiries of General Interest" page is more practical, requiring no handbooks or tables. Dividers cannot be set directly at exactly 6.156 in., so it would be a case of "cut-and-try" anyway, and a draftsman would have the trick done graphically while one was looking up a table in a book.—EDITOR.]

Simple Hand Damper Regulator

All who have tried know how hard it is to get close damper adjustment with any hand regulator employing a system of notches into which the damper cable or wire is hooked by a catch.



ADJUSTER FOR HAND-OPERATED DAMPER

I recently installed in my plant a device, the principle of which I took from the carbon clutch in the ordinary arc lamp. It is simple in construction, easy and sure in its operation and can be adjusted to give any desired reading of the draft gage.

The necessary things are a piece of ⅜- or ½-in. pipe, an old rubber pump valve four or five inches in diameter and about ⅝ in. thick, with a hole at the center somewhat larger than the outside diameter of the pipe, a couple of pieces of wood, a pair of pipe straps and a few small screws.

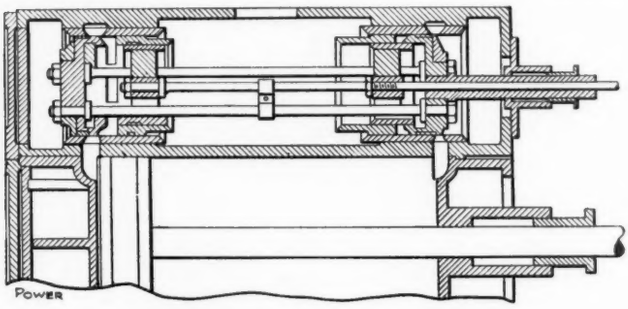
The accompanying sketches show how the parts are assembled.

W. G. GREENLEES.

El Campo, Texas.

Bent Rods Measured with Wire

I had an accident recently with a Buckeye engine of 200 hp. The nuts came off the rods on the inside of the main steam valve, and the rider valve was left to act at its own option. It did not act very well, shutting



NUTS CAME OFF LONG RODS

the engine down with 80 lb. of steam pressure on. These rods were bent so that it was difficult to remove them and to get their exact length. I bent some wire solder, which is flexible, to follow the shape of the bent rods, and in that way got the proper length of the rods.

WILLIAM BURLEY.

Xenia, Ohio.

Repairing Commutators

Having lately noticed in POWER a method of repairing holes in commutators by filling them with paste, I shall describe a method used with good results on 600-volt railway converters, which are at times heavily overloaded.

Where the hole is at the front end of the commutator, take a hacksaw blade the thickness of the mica and saw down between the bars, being careful to saw straight, until the burned mica is cleaned out and the bottom of the cut is free. Now take some sheet mica of sufficient thickness to press it in with the fingers and fit as tightly as possible without buckling. Be sure that the edge of this patch is straight. Having fitted the patch in the cut, remove it and coat it, as well as the inside of the slot, with shellac.

Now press the patch in firmly and, with a screwdriver and tack hammer, gently calk the bars on each side of the patch, and on top at the end of the bar, but not quite to the ends of the patch. Cut off the patch by cutting sideways with a sharp knife and smooth with sandpaper. The main thing is to get a good fit at the bottom; if this is not done, the current will jump through and again burn out the mica. With a good joint at the bottom, the calking will hold the patch in place and the job will last indefinitely. I have some commutators repaired in this way that have been running three years.

Trouble can often be prevented by rounding the corners of the bars to a radius of about ⅛ in., as a square corner leaves a sharp point and invites the current to jump across.

H. W. GINAVEN.

Springfield, Ohio.

Depolarized Generator

Three separately excited, two-phase, 220-volt, alternating-current generators of different sizes and speeds were connected to a switchboard with two sets of busbars and a number of double-throw switches. No. 1 generator leads connected to one set of busbars and led to one side of the switch contacts. No. 2 leads connected to the other set of the busbars and supplied current for the other side of the switch contacts. The power lines were connected to the middle contacts. The leads from No. 3 generator were connected to the middle contacts of a double-throw switch and could be made to supply either set of busbars. It is evident that only two generators could be in use at one time.

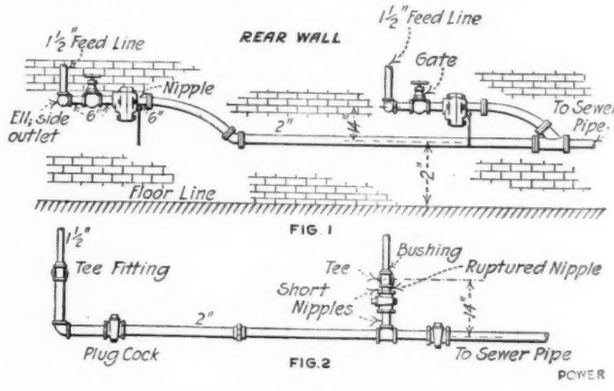
One evening on starting No. 3 machine no current could be generated. After thoroughly looking it over and finding nothing wrong we came to the conclusion that the day engineer had been operating No. 3 on No. 2 side while No. 2 was down, and in starting the latter forgot to change the control switch for No. 3 to the other side (No. 1 being down) before the current had passed through No. 3. We therefore reversed the field leads on No. 3 and started up, and it generated immediately. The engine was stopped, the leads connected in correctly and we had no further trouble.

HERBERT HOLROYD.

Philadelphia, Penn.

Change in Blowoff Piping

When I took charge of this plant one of the blowoff lines leaked. Fortunately, it occurred near the end of the week, and a clamp and a piece of sheet packing held it until Saturday afternoon, when the boilers were emp-



IMPROVED BLOWOFF CONNECTION

tied. The following day I replaced this line, as shown in Fig. 1, dispensing with the short nipples and permitting of an easier flow of water from the boilers.

Fig. 2 shows the old line with short rigid connections.

FREDERICK L. JOHNSON.

Paterson, N. J.

Inquiries of General Interest

Temperature of Feed Water woth Double-Tube Injector—Can water be fed into a boiler with a double-tube injector at a temperature greater than 212 deg. F.?

S. C.

Double-tube injectors are made for locomotive service, which are adapted to feeding against 200-lb. boiler pressure, and by reducing the water supply the temperature of the feed can be raised above 212 deg. F.

Pitch of a Gear Wheel—What is meant by the term "pitch" as applied to gear wheels?

L. A. M.

The term refers to the spacing of the teeth. Circular pitch is the distance from the edge of one tooth to the corresponding edge of the next tooth, measured along the pitch circle. Diametral pitch is the number of teeth to each inch of diameter of the pitch circle, therefore circular pitch = 3.1416 ÷ diametral pitch, or diametral pitch = 3.1416 ÷ circular pitch.

Relative Water Level in Connected Boilers—Where two or more boilers discharge their steam into the same header, is it practicable to maintain the same or a relatively uniform water level in the boilers by connecting together their blowoffs and feeding into one boiler?

H. B.

For discharge of water to take place from one boiler to another through connected blowoffs or a similar connection, there must be enough difference of water level to equal the head required for the velocity of the flow and for overcoming the friction. Therefore, when the boilers are steaming, the same level of water in the different boilers could not be maintained by feeding one boiler and connecting together the blowoffs of the boilers.

Impurities in Feed Water—What are the principal scale-forming impurities in feed waters, and what are the temperatures at which they are thrown down by heat?

F. W. G.

The impurities most commonly present which form boiler scale are calcium carbonate ($CaCO_3$), magnesium carbonate ($MgCO_3$), calcium sulphate ($CaSO_4$) and magnesium sulphate ($MgSO_4$). The carbonates begin to deposit when the water is heated to about 180 deg. F., and by the time it has reached 212 deg. F. the greater part of the carbonates will be deposited, and all the carbonates will be deposited when the water has attained a temperature of about 290 deg. F., which is the temperature of evaporation of water under a gage pressure of about 43 lb. per sq.in. The sulphates remain in solution until a temperature of about 300 deg. F. (52.3 lb. gage pressure) is reached, when they become insoluble and settle.

Boiler Efficiency vs. Efficiency of Boiler and Grate—What is the difference between "efficiency of the boiler" and "efficiency of the boiler and grate?"

H. B. G.

(1) Efficiency of the boiler =

$$\frac{\text{Heat absorbed per pound of combustible}}{\text{Calorific value of 1 lb. of combustible}}$$

being the ratio of the heat absorbed in generation of steam to the heat contained in the combustible that was actually burned, irrespective of how much may have dropped through the grate.

(2) Efficiency of boiler and grate =

$$\frac{\text{Heat absorbed per pound of coal}}{\text{Calorific value of 1 lb. of coal}}$$

being the ratio of the heat absorbed in generation of steam to the heat contained in the coal used.

The first is the one understood when the words "boiler efficiency" are used without qualification, and is of value in comparing relative performances of boilers apart from the particular kind of grate used; the second is of value in comparing performances of different kinds of fuels, grates, etc., used with the same boiler.

Steam Required for Warming Air—How much steam would be required if supplied and condensed at atmospheric pressure, to raise the temperature of 25,000 cu.ft. of air from 15 deg. F. to 120 deg. F.?

P. H. M.

In condensing, the steam would liberate its latent heat of evaporation, viz.: 970.4 B.t.u. per lb. of steam condensed. A cubic foot of air at 15 deg. F. weighs 0.0836 lb., and the heat required to raise a pound of air 1 deg. F., i.e., its specific heat, is 0.2377 B.t.u. As 25,000 cu.ft. of air at 15 deg. F. would weigh

$$25{,}000 \times 0.0836 = 2090 \text{ lb.}$$

and each pound of air raised from 15 deg. F. to 120 deg. F. would require 0.2377 B.t.u. × (120 — 15) = 24.9585 B.t.u., then the total heat required would be

2090 lb. of air × 24.9585 B.t.u. per lb. = 52,163.265 B.t.u.

requiring the condensation of

$$\frac{52{,}163.265}{970.4} = 53.75 \text{ lb. of steam.}$$

Sizes of Ports and Pipes—What is the rule for the area of ports and pipes of high-speed engines with strokes 1 to 1½ times the diameter of cylinder and speeds of 200 to 300 r.p.m.?

J. W. W.

The same size of ports would be used for steam as for exhaust. The area of steam pipes and ports would be expressed by the formula

$$a = \frac{AV}{C}$$

in which

a = Area of pipe or port in square inches;
A = Area of piston in square inches;
V = Mean piston speed in feet per minute;
C = Mean velocity of the steam through the port or pipe in feet per minute.

For ordinary piston speeds of about 600 ft. per min., C, in a formula for ports, may be taken as about 5500, hence

$$a = \frac{A \times 600}{5500} = 0.109\,A$$

i.e., the area of ports would be about 11 per cent. of the area of the piston. Allowing for a mean velocity of steam in the steam pipes of 6500 ft. per min., the area of pipe would be

$$a = \frac{A \times 600}{6500} = 0.0923\,A$$

so that the diameter of the steam pipe would be about 0.3 the diameter of the cylinder. For noncondensing engines, the exhaust pipes may be about 0.37 the diameter of the cylinder.

Equivalent Evaporation from and at 212 deg. F.—A boiler required 500 lb. of coal for the evaporation of 3000 lb. of water into steam at atmospheric pressure. The feed-water temperature was 160 deg. F., and the coal contained 80 per cent. of combustible. What was the equivalent evaporation per pound of combustible from and at 212 deg. F.?

P. H. M.

The combustible used was 80 per cent. of 500, or 400 lb. of combustible, and the evaporation under actual conditions was

3000 ÷ 400 = 7.5 lb. of water per pound of combustible.

The temperature of feed water being 160 deg. F., each pound of feed water contained

$$160 - 32 = 128 \text{ B.t.u.}$$

above 32 deg. F., and as a pound of steam at atmospheric pressure contains 1150.4 B.t.u. above 32 deg. F., then for conversion into steam at atmospheric pressure each pound of feed water would have to receive

$$1150.4 - 128 = 1022.4 \text{ B.t.u.}$$

The heat required to evaporate a pound of water from and at 212 deg. F. or latent heat of evaporation at that temperature is 970.4 B.t.u., therefore the factor of evaporation is

$$\frac{1022.4}{970.4} = 1.0536$$

hence, the equivalent evaporation from and at 212 deg. F. was

$$7.5 \times 1.0536 = 7.9 \text{ lb.}$$

of water per pound of combustible.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—EDITOR.]

Engineers' Study Course

Problems in Power-Plant Design--VI

Auxiliary Equipment

The present article takes up the proportioning of the various auxiliaries required in a large power plant, and gives a certain amount of working data connected with them.

Condenser

The four general types of condensing apparatus in common use are surface, jet, barometric and atmospheric. Each of these has its advantages under different conditions. The jet condenser is less bulky than the surface condenser, and when the water is of good quality and the oil is thoroughly removed from the exhaust steam, so that the boilers may be fed from the discharge water, it is a desirable type to employ.

The surface condenser is commonly used where the water is of poor quality and where it is desired to use the condensed steam over and over in the boilers, adding about 10 per cent. of fresh water to overcome the corroding effect of distilled water. Here, as in the case of a jet condenser, the oil must be thoroughly removed from the exhaust steam before it is condensed, unless some special form of settling chamber or tank is provided. In the present problem we will assume that the water-supply contains a sufficient amount of impurities to call for a surface condenser.

The weight of cooling water required by a surface condenser, operating under average conditions, is about 35 times that of the steam condensed, when used with a reciprocating engine. The cooling surface in the tubes may be found by the formula

$$S = \frac{WL}{180\,(T - t)}$$

in which,

S = Square feet of cooling surface;
W = Weight of steam to be condensed per hour;
T = Temperature of steam at condenser pressure (about 140 deg. for average conditions);
L = Latent heat of steam at condenser pressure, (1013 for a temperature of 140 deg.);
t = Average temperature of cooling water (about 90 deg. for summer conditions).

Substituting the proper values for the present case in the formula, gives

$$S = \frac{(670 \times 18) \times 1013}{180\,(140 - 90)} = 1357\ sq.ft.$$

The pumps are usually furnished as a part of the condensing equipment and are proportioned for the work by the makers, so that no computations will be made here.

Feed-Water Heaters

Under normal summer conditions the only cold feed to be supplied is the "makeup" water, which, as previously stated, should amount to about 10 per cent. of the evaporative capacity of the boilers. In the winter, when the heating system is in use, the maximum waste of steam to be replaced by fresh water will be the difference between the exhaust from the combined power and lighting engines and that utilized for heating and ventilating. The total exhaust of the main units at this period will be

$$(670 \times 24) + (158 \times 20) = 19{,}240\ lb.$$

per hour, which increased by that used by the pumps will be approximately 20,000 lb. The amount utilized for heating and ventilating in zero weather was found to be 12,291 lb. per hr., which will, of course, diminish as the outside temperature rises. It will be shown later how to determine accurately the point at which it will be more economical to run the main engine condensing and heat with live steam, but this may be computed approximately as follows. In changing from noncondensing to condensing it was assumed that the steam consumption of the main engine will drop from 24 to 18 lb. per i.hp.-hr., making a total saving of

$$670 \times 6 = 4020\ lb.$$

of steam per hour from which must be deducted approximately

$$40 \times 18 = 720\ lb.$$

for pumping the condensing water from the river, leaving a net gain of

$$4020 - 720 = 3300\ lb.\ per\ hr.$$

When the steam required for heating purposes becomes less than this, it will evidently be advisable to run condensing and heat with live steam.

As the steam required for heating varies as the difference between the inside and outside temperatures, it will be diminished for an inside temperature of 60 deg., by one-sixth for each 10 deg. rise in outside temperature, or in the present case

$$12{,}291 \div 6 = 2048\ lb.$$

With an outside temperature of 50 deg. the steam requirements for heating will be approximately 2045 lb. per hr.; at 40 deg., 4090 lb., and at 45 deg., 3067 lb. It is evident that the economical point of changing from noncondensing to condensing will occur with an outside temperature between 40 and 45 deg.

If the feed-water heater be made of sufficient size to heat the water to replace the exhaust wasted at 45 deg. outside temperature, it will meet all requirements. This is evidently

$$20{,}000 - 3067 = 16{,}933\ lb.\ per\ hr.$$

or 17,000 lb. in round numbers. The required amount of heating or tube surface depends upon the initial temperature of the feed water, the steam pressure within the heater and the velocity with which the water flows through the tubes. With exhaust steam from noncondensing engines, it is customary to allow about one square foot of heating surface for each 90 lb. of water passed through the heater per hour. When exhaust from condensing engines is used, the surface should be increased about 50 per cent., owing to the lower temperature of the steam.

In the present case the heater will do its maximum work when the engine is running noncondensing and will therefore require

$$17{,}000 \div 90 = 188.8$$

or say 190 ft. of tube surface.

Commercial heaters are commonly rated in horsepower, based on $\frac{1}{3}$ sq.ft. of heating surface per horsepower when used with noncondensing engines, and $\frac{1}{2}$ sq.ft. per hp. for condensing engines. This, in the problem under consideration, calls for a heater rated at

$$190 \times 3 = 570 \ hp.$$

or practically the same as the normal rating of the boiler plant. This long process of determining the size of heater may seem useless in the present case, but under different conditions the result might bear a different relation to the capacity of the boiler plant, and the reader should be familiar with the methods of working out problems of this kind.

The temperature to which the feed water may be raised usually varies from 200 to 210 deg. with steam from noncondensing engines, and from 110 to 120 deg. with condensing engines. This makes it advisable in some cases to provide a secondary heater arranged to take the exhaust from the various pumps, passing the water through the heater supplied with steam at condenser pressure first and then through the second heater taking the pump exhaust at atmospheric pressure. In this way a considerably higher feed temperature may be obtained, depending upon the amount of exhaust at the higher pressure. In the present instance, during the summer, only steam at condenser pressure will be available for feed-water heating and it would evidently be of advantage to utilize the exhaust from the auxiliary pumps in a secondary heater rather than exhaust it outboard. The size of this heater may be estimated with sufficient accuracy as follows:

The exhaust from the auxiliaries commonly runs from 5 to 10 per cent. of that from the main engine. Assuming 8 per cent. as a fair average, this will amount to approximately

$$16{,}000 \times 0.08 = 1280 \ lb. \ per \ hr.$$

calling for

$$1280 \div 90 = 14 \ sq.ft.$$

of surface or a

$$14 \times 3 = 42 \ hp.$$

heater, the nearest standard size to which would be 50 hp.

Vacuum Pump

The size of the vacuum pump for connecting with the return from the heating system may be found by use of the following table, which is abridged from the *Metal Worker* of July 28, 1911:

TABLE 1—SIZE OF VACUUM PUMP

Factor	Size of Pump, In.	Factor	Size of Pump, In.
28,250	6 x 7¼ x 10	49,957	8 x 9¼ x 12
30,600	7 x 7¼ x 10	57,220	8 x 10 x 12
34,410	7 x 8 x 10	60,250	8 x 10 x 14
36,620	6 x 8 x 12	82,397	10 x 12 x 12
43,627	6 x 9 x 12	90,713	10 x 10 x 16

In using this table multiply the number of thermostatic or water-seal valves by 100, and to this add the equivalent square feet of direct radiation. Look for this sum or factor in Table 1 and use the size of pump corresponding. Applying this to the problem at hand, we have a maximum heat loss of 11,922,000 B.t.u. per hr., which requires the equivalent of

$$11{,}922{,}000 \div 250 = 47{,}688 \ sq.ft.$$

of direct radiation. Thermostatic valves will be required upon each section of each hot-blast heater and upon each direct coil and radiator. Assuming 100 of these to be required, we find the factor to be

$$(100 \times 100) + 47{,}688 = 57{,}688$$

which, according to Table 1, calls for an 8x10x12-in. pump.

Receiving Tank and Feed Pumps

The size of the receiving tank is usually estimated, and must be large enough to care for any sudden increase in condensation, as when steam is first turned on in the morning, without flooding. For a plant of the size under consideration, a tank 48x72 in. should be of ample size. If two feed pumps are used, each should be of sufficient size to do the entire work not exceeding a piston speed of about 50 ft. per min., or approximately 50 strokes per min., for continuous use. If three pumps are provided, two working together should be able to do the work, which will give a spare pump at all times. A 600-hp. boiler plant will require

$$\frac{600 \times 34.5}{8.3} = 2494 \ gal. \ per \ hr.$$

$$2494 \div 60 = 42 \ gal. \ per \ min.$$

Table 2 gives the capacity in gallons for duplex pumps of different size, based on 20 per cent. slippage and a maximum continuous speed of 50 strokes per minute.

TABLE 2—SIZE OF FEED PUMPS

Size of Pump, In.	Gal. per Min.	Size of Pump, In.	Gal. per Min.
4½ x 2¾ x 4	8	7½ x 5 x 6	40
5¼ x 3½ x 5	16	7½ x 4½ x 10	50
6 x 4 x 6	26	7½ x 5¼ x 10	70

Either the 7½x5x6-in. or the 7½x4½x10-in. pump would do the work required, but perhaps the larger size would be better for continuous service.

Blowoff Tank

The size of the blowoff tank depends upon the amount of water it is desired to remove from the boiler at one time. It is usually customary to blow off a small quantity at frequent intervals, and for this purpose it will usually be found sufficient to make the capacity of the tank about one-twentieth that of the total volume of the boiler, neglecting the tubes. If there are two boilers, the tank should be made twice the size, and so on. In a battery of several boilers they will probably be blown off in sections of two or three and the tank may be proportioned accordingly. In the present case we will assume that one battery, or three boilers, is to be blown off at one time. Total volume of three boilers equals

$$28 \times 16 \times 3 = 1344 \ cu.ft.$$

$$1344 \div 20 = 67.2 \ cu.ft.$$

which calls for a tank 4 ft. in diameter by 6 ft. long.

Ventilation of Boiler and Engine Rooms

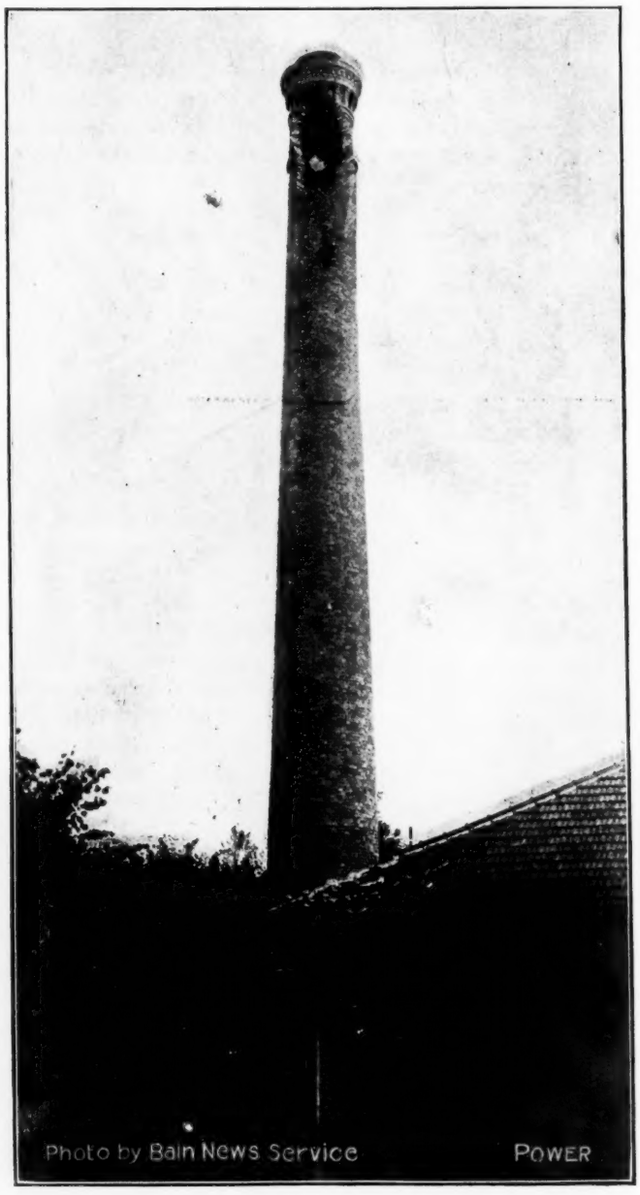
Boiler and engine rooms are usually ventilated by blowing in cool outside air, near or directed toward the floor, and allowing it to pass out through roof openings or monitors.

If the power house is above grade, so that fresh air may be admitted through doors and windows, a fan will not usually be necessary. In the present layout, with the boilers, pumps and condenser below the ground level, it will be advisable to provide artificial ventilation. This will require, for four changes of air per hour, about 7500

cu.ft. of air per min. As the subject of fans will be taken up later, we will only state here that from a fan table a 3½-ft. centrifugal fan running at 375 r.p.m. will deliver this amount of air and will require a 3-hp. motor for operating it. No special ventilation will be provided for the engine room, windows and monitor openings being depended upon for this purpose.

Chimney Hit by a Shell

Fortunately, few of our readers have the opportunity of seeing the effect of a high-velocity projectile on a brick



CHIMNEY NEAR RHEIMS HIT BY GERMAN SHELL

chimney at first hand. Here is the photograph of a chimney at Rheims, France, so damaged. We are indebted to the Bain News Service for this picture.

Cylinder Lubrication—A heavy cylinder oil should not be fed at the same rate, in drops per minute, as a lighter oil, for there is more substance in a drop of heavy than in one of light oil.

OVER THE SPILLWAY

JUST JESTS, JABS, JOSHES AND JUMBLES

THANKSGIVING!

In a couple of days we will honor the Pilgrim Fathers to the extent of taking a day off and stuffing ourselves to the ears with turkey and fixin's—and mebbe feel thankful that Thanksgiving Day comes but once a year. Somehow, the last few years, the holidays seem to have slipped their identity tag. Ask your boy Tommy what's Thanksgiving Day. Bet you two bits he'll say: "Gee, dad, it's another day us fellers don't have to go to school."

Most of our holidays mean a lot, though there's many a grown-up Tommy who can't remember if Feb. 12 is Arbor Day or Washington's birthday.

The Pilgrim Fathers were no village cut-ups, we'll admit. That they were a grim lot may have been due to trying to get 968,901 compatriots into the little "Mayflower," if we are to believe the claims of their descendants.

But the P. F. did celebrate the first Thanksgiving Day and it was a good hunch in that it is a reminder that we have slashings of things to be thankful for.

We have escaped the horrors of war, and our country is most wise in its neutrality; the daily supply of B.t.u. at the plant is still in our keeping; the doctor says our baby only has the snuffles—the other five (or 5+ as the case may be) are disgracefully healthy, and we are not well enough to be sick ourselves. Then, again, we can holler for the busy times that are bound to come all the quicker if we but believe in ourselves and our neighbors. Sure we are thankful!

"Fight to Keep the Family Home Intact," says a headline. It may be one way to do it, though we doubt if it will work out right. Our own home has remained intact for years chiefly because it took two of us to make a fight. To the trenches for us when we fight!

Scientist says drowsiness is the result of the nerve cells burning up all their fuel and getting clogged with ashes. Reckon we'll pull our fires and give ourselves the once over. As to the ashes—Mebbe we'll try Calorigene (see our editorial "Hail, Calorigene!" on page 749).

This is a burn-your-ashes-and-get-more-heat-than-from-coal stunt—when it works! Here's how we love Calorigene:

CALORIGENE

It's made us sore and roused our spleen;
No more our mind is gay, serene.
Old Trouble's hit us on the bean—
The reason is, Calorigene!

We've burned the midnight kerosene
And scoured the earth that we might glean
Some help to make our coal bills lean—
Oh, where were you, Calorigene?

Calorigene, Calorigene!
It is quite plainly to be seen
That you have acted doggone mean
To keep yourself so long unseen.

Could we from you one small hope glean,
We'd crown you queen, Calorigene,
If you could save one-half the coal
That's swallered by the furnace hole!

Calorigene, Calorigene!
Say if you're hep to what we mean—
If, when we reach that blessed shore
Where coal and ashes are no more,
Calorigene, if you prove true,
We'll back to earth and stay with you!

Seventh Annual Conference of Governors

At the annual Conference of Governors which was held at Madison, Wis., Nov. 10 to 14, an interpretation of the government's conservation policy was given which differs widely from the conception of this term as held by the majority of the people, at least in the older states of the Union.

The key note of this discussion was sounded by Governor William Spry of Utah when he read his paper on "State Control of Natural Resources."

As developed by this paper and the discussion which followed, there stand out two distinct criticisms of the present policy: First, a criticism of federal ownership and control of the lands, minerals, timber and water powers of the country. Second, a criticism of the idea which seems to prevail in official circles as to what "conservation" is:

The opinion of Governor Spry on the first of these questions is perhaps best expressed by the following quotation from his paper: "Now vast areas have been withdrawn from entry; new and radical departures in the regulations governing the handling of mineral and oil lands have been adopted and the cry is going up for the government ownership of all power sites. Under this policy, the states wherein the public domain as yet lies practically in its virgin state are deprived of that great benefit that accrued as a direct asset to the older states.

"Suppose the government leases mineral, coal and oil lands and water-power sites and remains forever vested of title. Who can estimate the loss in revenue from taxation that will be suffered by the states wherein the valuable resources are located, which revenues have been for years accruing to the older states?"

This is a point on which the Western governors appear to be unanimous. Their contentions along this line were also expressed by Governor Ammons of Colorado to the effect that the resources within the state are by right the assets of the state and not of the federal government.

Also it is claimed that on account of the close proximity to their resources, their knowledge of the conditions surrounding them, and the experience gained by long years of contact with these conditions, the state can more wisely administer these resources than can a bureau of the federal government far removed from the practical problems involved. Great stress is laid on the right of the state to derive revenues from these resources, in the way of taxes, for the support of the state government.

Governor Ammons stated that in Colorado only a trifle more than 25 per cent. of the area of the state was subject to taxation. The remainder is still vested in the federal government and held so that its development is impossible. This throws the burden of maintaining the government, construction of schools and roads and the development of a new state, on a very limited area and a few people, while in time the total area of the state will reap the benefits of the sacrifices of the few. If the state were allowed what it claimed to be its just rights it would develop a policy which would lead to the development and use of its resources and produce additional revenue for the maintenance and upbuilding of the state.

Governor Eberhart of Minnesota laid down two principles which he believes to be fundamental. First, a state should undertake no business which can be managed and conducted equally well for all parties concerned by private ownership. Second, the federal government should undertake no business which can be managed and conducted equally well for all parties concerned by a state government. He cited the question of water powers as coming under the second head and believes the states should be allowed to control the water powers within their borders, but the state must insure proper regulation.

In answer to the objection that the older states have often allowed their resources to get away from them without proper compensation, it was stated that nearly all of the states now have commissions to look after their interests. It is also claimed that these commissions, being in closer contact with the local conditions, would be in a better position to pass on the adequacy of the returns than would be a federal board to which the same question might be referred.

Passing from states' rights to conservation, there seems to be the same unanimity on the part of the governors from the Rocky Mountain district. The prevailing sentiment may again be expressed from Governor Spry's address. After reciting some of the provisions of the earlier government land laws and the development of the newer states under those laws he makes the following statement:

Remote from the thickly populated centers these Western states waged a vigorous campaign of land and resource exploitation in an effort to put their capital on an earning basis. Altogether, the so-called desert and waste places of the North American Continent gave abundant evidence of being among Nature's most favored localities, and spots where she had with lavish hand provided the valuable resources, which when converted to useful purposes build up communities, states and nations.

A halt was suddenly called to this growth and development. Uncertainty took the place of confidence and a condition of paralysis overtook the West. Covetous eyes looked upon the heritage of the public land states.

Referring to the first Conservation Congress, called by President Roosevelt, he says: "The conference developed into a spectacular, wordy exploitation of alleged facts regarding the exhaustion of the natural resources. The moderate expressions of fear that wanton waste would work a hardship on future generations were relegated by a self appointed coterie of resource guardians. Statistics were presented, and at the time undisputed, to prove that in a short time the vast mountain ranges would be stripped of ore, that the iron age would be a thing of the past, that people would actually suffer from cold from the lack of coal, that the great American republic would soon face veritable bankruptcy of public resources."

In the discussion of the depletion of natural resources, Governor Ammons stated that there was enough coal in his state to supply this country for the next three hundred years and that Wyoming had a much larger supply. He asserted that there is a greater growth of timber in this country at the present time than is required for the present use, and that timber is being supplanted by other and better building materials.

He stated that only 4½ per cent. of the water powers of Colorado has been developed up to this time and they have not been able to market that on account of the retardation of development.

The general sentiment in respect to the various resources seemed to be the one which is so often expressed in regard to water powers, i.e., the only way to conserve them is to use them. These governors believe that the settlement of their lands, the development of their water powers, and the use of their forests under proper regulations is the correct policy to follow at the present time. They believe that the so-called conservation policy now followed by the federal bureaus is, in fact, rather a policy of stagnation so far as the West is concerned.

The proposed leasing system is not acceptable to the people of the West as it allows the title to be vested in the government and is therefore not subject to taxation no matter how valuable it may be. The only acceptable leasing system would be one in which all of the revenue accruing shall be turned over to the state. This they consider their just deserts.

A friendly challenge was laid down for any of the governors present to show wherein the position taken by the Western governors was in error. No governor present seemed to be inclined to enter the controversy on the floor of the conference.

The position of the Western group is perhaps best summed up by the following quotation from Governor Spry:

The natural resources within the given boundaries of a state constitute the capital upon which that particular state must conduct its business and that capital should not be impaired by stagnation. The business of the government and the business of the state is being properly conducted only when the public lands go to bona fide homeseekers, when the minerals are being converted into wealth, when the waters are being used for navigation, irrigation, and power, and when the timber is being cut to build homes, school houses and public buildings.

Important Rate Decisions

The recently published report of the Public Service Commission of Missouri contains the proceedings of two electric rate cases, in both of which a substantial reduction in charges to the consumer was ordered.

SPRINGFIELD GAS & ELECTRIC CO.

In the case of the Springfield Gas & Electric Co. a maximum rate of 15 cents per kw.-hr. was being charged. Under the revised schedule ordered by the commission, the rates are as follows: Residence lighting, 8 cents per kw.hr. for the first 30 hr. and 5 cents per kw.-hr. for the remainder, with a minimum bill of 75 cents per month; general lighting, 8 cents per kw.-hr. for the first 30 hr., 5 cents for the next 60 hr., and 3½ cents for the remainder, with a minimum bill of 5 cents per month for each 60-watt equivalent of connected load, there being no charge less than $1 per month; general power, 8 cents per kw.-hr. for the first 30 hr., 5 cents for the next 60 hr., and 3½ cents for the remainder, with a minimum bill of 75 cents per month for each kilowatt of connected load; large light and power service, 7 cents per kw.-hr. for the first 30

hr., 4 cents for the next 30 hr., 3 cents for the next 60 hr., and 2 cents for the remainder, with a minimum bill of $1 for each kilowatt of maximum demand; street lighting, $60 per annum per 7.5-amp. lamp and $6 per annum per 40-watt lamp. Provision is also made for a 10 per cent. discount on residence lighting, general lighting and power, and 5 per cent. on large light and power service, if the bills are paid within 10 days.

In arriving at this schedule the commission carefully investigated the values of the properties involved, the operating expenses, overhead charges and revenue. It refused to allow a separate and distinct item for "going value" or "good will," but did take into consideration, in fixing the present fair value of the property, that the plant was in successful operation as a going concern. It refused to allow a franchise value as an item in rate making, but conceded such a value in case of sale or condemnation. An attempt was also made by the company to capitalize the going value of an efficient office force; this was denied by the commission.

It appears that the defendant company, in an endeavor to boost its capitalization after the proceedings had begun, attempted through a tripartite agreement to transfer to itself ownership of the steam plant belonging to the Springfield Traction Co., from which it had purchased electricity at 1.2 cents per kw.-hr. This the commission would not allow and finally fixed the value of the defendant's property at $300,000, as against a claimed valuation of over $800,000.

After allowing a reasonable amount for overhead charges and operating expenses the commission fixed 7 per cent. as a fair rate of return on the investment and fixed the rates accordingly.

KIRKSVILLE LIGHT, POWER & ICE CO.

The second case was that of the Kirksville Light, Power & Ice Co., a small central station of only 300-kw. capacity, which had been charging at a sliding scale from 15 to 6 cents per kw.-hr. After thorough investigation the commission ordered approximately a 25 per cent. reduction in rates and prescribed the following schedule: 10 cents per kw.-hr. for the first 30 hr. of use per month, 7 cents for the next 30 hr., and 4 cents for the remainder. A minimum charge of 75 cents per month for residences is provided, and 5 cents for each 60-watt equivalent of connected load for commercial service.

As in the other case, 7 per cent. was allowed as a fair rate of return after providing for reasonable operating expenses, depreciation and contingencies. Commenting on low rates, the commission said: "Low rates for long-hour or day-time electricity from a lighting plant can be justified only on the basis that the rates charged reduce the cost to all consumers and that there is no discrimination among consumers or classes of consumers."

"Balanced Draft" Patents Upheld

A patent decision of interest to steam-boiler plant owners and operators was recently handed down by Justice Hough, of the United States District Court for the Southern District of New York. By this decision are sustained the basic patents issued to Embury McLean, covering the combination of apparatus and the method of operating a furnace which has come to be known as the "Balanced Draft" system.

These patents are owned by the Engineer Co., which will thus be given the exclusive right to install "Balanced Draft."

ENGINEERING AFFAIRS

American Institute of Steam Boiler Inspectors—At the regular meeting to be held at 29 West Thirty-Ninth St., New York City on Nov. 27, at 8 o'clock p.m., Charles S. Blake, secretary of the Hartford Steam Boiler Inspection & Insurance Co., will lecture on boilers and boiler explosions, with stereopticon views. Mr. Blake has gone through the mill as an inspector and is thoroughly qualified to give some instructive information.

Naval Architects and Marine Engineers' Meeting—The twenty-second general meeting of the society of Naval Architects and Marine Engineers will be held in the Engineering Societies Building, 29 West Thirty-Ninth St., New York, Thursday and Friday, Dec. 10 and 11.

Following is a list of the papers to be presented: "International Conference on Safety at Sea," by Hon. E. T. Chamberlain; "Safety of Life at Sea. Application of Subdivision Rules Adopted at International Conference," James Donald; "Safety of Life from Fire at Sea," W. O. Teague; "Launching Data for a Battleship," Naval Constructor J. G. Tawresey, U. S. N.; "Stability of Vessels as Affected by Damage Due to Collision," William Gatewood; "Expansion or Contraction of Certain Dimensions and the Effect upon Resistance," Prof. H. C. Sadler; "Some Experiments with Models Having Radical Variations of After Sections," Naval Constructor D. W. Taylor, U. S. N.; "Recent Developments in Submarine Signaling," J. B. Millet; "The Thermodynamics of the Marine Oil Engine," John F. Wentworth; "Refueling of Warships at Sea," Spencer Miller; "Our First Frigates. Some Unpublished Facts About Their Construction," Hon. F. D. Roosevelt, Assistant Secretary of the Navy; "The Behavior of Riveted Joints under Stresses," James E. Howard; "The Present Status of Marine Diesel Engine Installations," W. R. Haynie; "The Application of Electric Propulsion to Battleships, together with the Experience Gained in the 'Jupiter,'" Lieut. S. M. Robinson, U. S. N.

Associated Engineering Societies of St. Louis—Ernest J. Wiederholdt, president of the Wiederholdt Construction Co., chimney builders, presented an illustrated paper on "Various Types of Chimneys" before the Associated Engineering Societies of St. Louis on Wednesday evening, Nov. 4. Mr. Wiederholdt discussed and illustrated types of guyed and self-supporting steel, common- and radial-brick, concrete, tile-concrete, and brick-concrete chimneys, discussing the points of advantage of each type. He also illustrated the advantage of protecting chimneys from lightning by throwing on the screen photographs of unprotected chimneys that had been damaged.

Joint Conference on Aviation—The Aëronautical Society of America, in collaboration with many national engineering organizations in this country, on Feb. 5 and 6, 1915, will consider inventions tending to increase the stability and safety of flight in heavier-than-air machines. The Board will do this with a view of preparing for the meeting of the joint conference such data as may enable forming a clear and correct judgment of the value of the invention, and will collaborate to this end with the inventor to the best of its abilities. The inventors, after the conference, may be given a certificate showing that their invention has been submitted to the joint conference; if the conference so decides, the opinion passed on the invention may be included in the certificate.

PERSONALS

Robert F. Carr, president of the Dearborn Chemical Co., at the recent Illinois state election was elected a trustee of the University of Illinois, from which he was graduated in Chemistry in 1893. Mr. Carr's plurality over his opponent was about 30,000. The university's board of trustees is composed of nine elective members, three to be elected every two years for a term of six years. The other members are the governor of the state, the state superintendent of public instruction and the president of the state board of agriculture.

What is Fuel Oil?—Fuel oil is frequently referred to as crude oil and possibly this is the reason for the erroneous idea of its danger, for crude oil is called a fuel oil only when its flashing point is nigh and it is comparatively free from gasoline and naphtha. Crude oil itself is a mixture of a number of hydrocarbons which may be separated through the agency of heat and the first distillate gases given off in refining are very explosive so that such an oil cannot be safely used as a fuel oil.

Gasoline is driven off at a temperature of from 140 to 160 deg. F., during the distillation of crude oil, and at a temperature of 200 deg. the lighter benzines or naphthas have been separated from the crude. The residue, should distillation be stopped at this point, would be an oil that could be handled as safely as coal, but the specifications for fuel oil generally call for a fire test of 250 to 300 deg. F. Such oil contains little naphtha and cannot ignite accidentally if ordinary precautions are taken. A shovelful of red-hot ashes can be thrown into a tank of this oil without danger, or a red-hot poker may be used to stir it without fear of an explosion or ignition.

Following in the order in which the various oils are distilled from crude comes kerosene, which constitutes about one-half the mixture. This is also a good oil for fuel, but is naturally considerably more expensive than fuel oil and cannot be, therefore, considered as a practical substitute for coal for any but very small engines.